

**Report on
BBMP Street Dog Estimate Survey-2023**



**A Joint Endeavour of
Bruhat Bengaluru Mahanagara Palike (BBMP),
Worldwide Veterinary Service (WVS) &
ICAR - National Institute of Veterinary Epidemiology and Disease
Informatics (NIVEDI)**

Foreword

I take immense pride in sharing the facts of "BBMP Street Dog estimate Survey: 2023" a result of the combined efforts of the Bruhat Bengaluru Mahanagara Palike (BBMP), Worldwide Veterinary Services (WVS) and ICAR-National Institute of Veterinary Epidemiology and Disease Informatics (ICAR-NIVEDI).



My heartfelt gratitude goes out to all contributors from dedicated field teams to the welcoming communities. This exercise aids in taking up community based dog care projects which focuses on Street Dog Population Management and controlling Dog-mediated Zoonotic Diseases including Rabies which result in a rabies free - healthy dog population, an environment where both residents and street dogs can live-in harmony and to build a city that cherishes empathy, diversity and coexistence.

A handwritten signature in blue ink, appearing to be 'G. S. S.', written over a faint watermark of 'ICAR-NIVEDI'.

Chief commissioner
Bruhat Bengaluru Mahanagara Palike

Preface

Bruhat Bengaluru Mahanagara Palike (BBMP) carried out the much needed systematic street dog estimation survey using NAPRE recommended method (sight-resight) in all the wards of Bangalore city to study the impact of the on going ABC-ARV program, to know the neutering percentage and ward-wise density of stray dog population. This estimate would help in improving the systematic implementation of ward wise ABC-ARV programme to achieve gradual reduction of stray dog population; reduction in human-dog conflicts and safeguarding public health.



The Design of Sampling plan for the Dog survey estimate including Analysis and Report was given by Dr. K. P. Suresh, Principal Scientist (Biostatistics) ICAR-NIVEDI in coordination with Dr. Hemadri Diwakar, Principal Scientist (Virology), ICAR-NIVEDI. Dr. Balaji Chandrashekar, Operations Manager, WVS provided technical support in survey through WVS data collection app to collect data efficiently by the surveyors. Through the use of smartphone technology and a combination of survey methods, a total number of 100 surveyors (AHVS/BBMP staff and volunteers) in 50 teams carried out the survey efficiently.

The concluded survey reveals a drop in stray dog population by 10%, increase in neutering percentage by 20% and reduction in puppy numbers. Based on the survey report, a strategic plan will be implemented by the Animal Husbandry Department, BBMP, to make the 08 zones of BBMP Rabies free and 100% neutering of stray dogs and BBMP as the role model in INDIA, in ABC/ARV implementation

D. S. Suresh
Special Commissioner (Health & AH)
Bruhat Bengaluru Mahanagara Palike

Acknowledgement

Pioneering Urban Coexistence through Collaborative Endeavours

Bruhat Bengaluru Mahanagara Palike (BBMP) in collaboration and coordination with the Worldwide Veterinary Services (WVS) and ICAR-National Institute of Veterinary Epidemiology and Disease Informatics (ICAR-NIVEDI), undertaken "BBMP Street Dog Survey: 2023". The highlights of the Street Dog estimate Survey is presented in this report.

This report serves as a testament to our collective pursuit—a pursuit animated by a shared aspiration to cultivate an healthy environment for both residents and Street Dogs.

This experience has reinforced our conviction in the potency of collaboration and ignited our sense of responsibility in Street Dog Population Management, controlling negative impacts of Dog-mediated Zoonotic Diseases including Rabies and human dog conflicts.

Warm regards

BBMP, WVS & ICAR-NIVEDI

① DR. RAVIKUMAR JP, BBMP - *[Signature]*
27/19


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ICAR-NIVEDI

BBMP Street Dog Estimate Survey: 2023

1. Introduction

Dogs, renowned for their loyalty, diversity of breeds, and innate ability to forge connections, have made them a permanent part of the urban ecosystem. The free ranging Street Dogs or the street dogs which are owned, need to be looked upon with compassion and seen that they are not overgrown in population to cause problems to their human companions.

In this context, the Bruhat Bengaluru Mahanagara Palike (BBMP) embarked on a significant endeavour that extends well beyond its typical municipal duties. As the custodian of Bengaluru's civic amenities and Stray Animals, BBMP's mandate extends far beyond the realm of roadways and waste management. In a bid to comprehensively address the dynamic relationship between the city's human and canine inhabitants, BBMP conducted a most awaited dog survey. This survey, a testament to BBMP's commitment to effective civic management, holds immense importance in shaping policies, fostering harmonious coexistence, and ensuring the well-being of both the city's residents and its four-legged companions.

Bruhat Bengaluru Mahanagara Palike (BBMP) is carrying out Animal Birth Control-Anti Rabies Vaccination (ABC-ARV) program in all of its 08 zones. In order to study the impact of the ongoing ABC-ARV program on the Street Dog population in Bengaluru, it is necessary to carry out systematic Survey estimation of the street dog's population using National Action Plan for dog Mediated Rabies Elimination (NAPRE) recommended method (single sight and sight-resight surveys) in Bengaluru city (BBMP) with the following objectives:

- To estimate the present neutering percentage among Street Dogs.
- To analyze and understand the geographical distribution and ward-wise density of Street Dog population.
- To work out a ward-wise micro plan.
- To fix reliable and realistic ward wise ABC-ARV targets based on estimated Street Dog population.
- To intensify and undertake systematic ARV drive so that 70% of the Street Dog population is vaccinated.

2. Methodology

2.1. Study Area

The study was conducted in the wards of BBMP in Bengaluru Urban district located in the southern part of India with coordinates of 12° 58' 17.7564" N and 77° 35' 40.4376" E between 11th July 2023 and 2nd August 2023. BBMP jurisdiction has 243 wards. These 243 wards are divided into 6850 grids (micro zones) for Survey purpose.

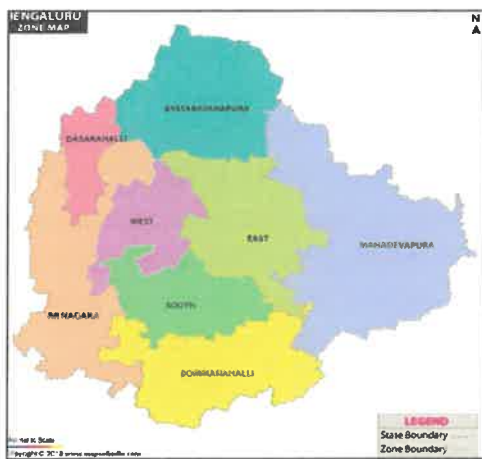
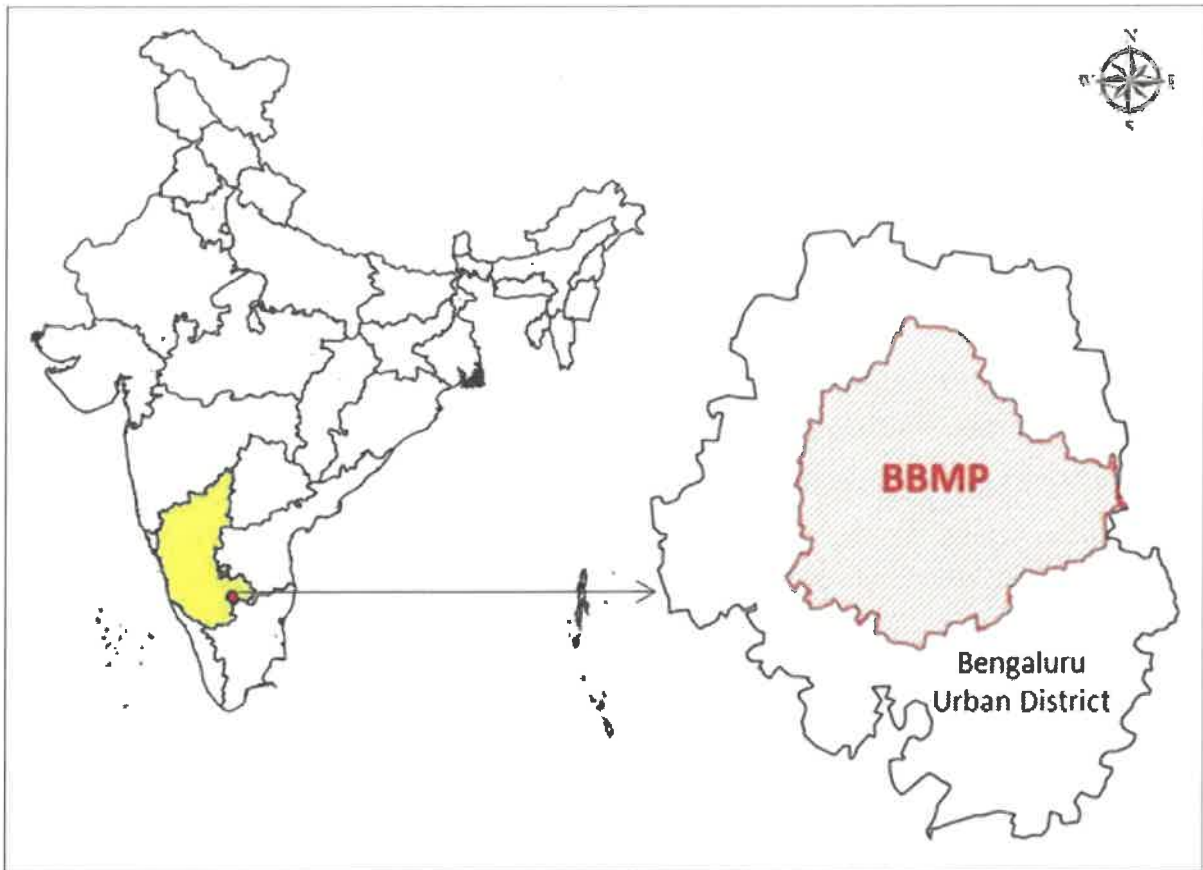
2.2 Selection of the Micro-zones

The micro zones (n=6850) each having an area of 0.5 Sq.km, were created within the 243 wards for more detailed and precise analysis of data. It is assumed that this level of granularity allows for a better understanding of localized trends and variations with reducing the risk of missing important data points and ensures a comprehensive assessment. Challenges or opportunities identified in specific zones can be addressed with tailored solutions, optimizing resource allocation and efforts.

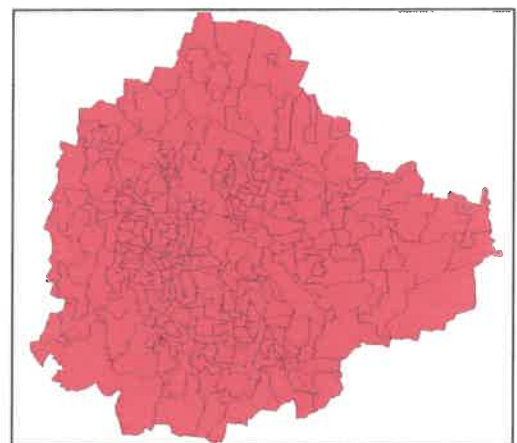
The methodology employed for the selection of wards involved the utilization of Stratified Random Sampling. With a total of 243 wards and 6850 micro zones, the aim was to ensure a representative sample. To achieve this, the Sample size formula $m1 = \left(\frac{200}{Q}\right)^2 \left(\frac{s}{N}\right)^2$ or 20% of the sampling results, whichever is higher was used. A total of 1360 micro zones, were required to be chosen for analysis.

The initial step involved the subdivision/stratification of the 6850 micro zones into four distinct categories, carefully aligned with the unique facets of the urban environment. These categories encompassed micro zones surrounding lakes, in slum areas, in commercial areas, and other general areas. By categorizing the micro zones into these four strata, the methodology acknowledged and embraced the diversity inherent in the city's fabric. The micro zones within the each strata were meticulously chosen for inclusion in the survey. This methodical selection process was driven by the aim to capture a cross-section of the city's various dynamics and characteristics, thereby enhancing the validity and reliability of the survey outcomes.

To uphold the integrity of the sample, the selection process involved picking minimum five micro zones from each ward. This systematic approach of selecting micro zones from different wards while maintaining the prescribed quantity within each ward adheres to the principles of Stratified Random Sampling. This technique was chosen to provide an accurate and well-rounded understanding of the city's diverse dynamics. By embracing a systematic and balanced approach to selecting wards and micro zones, the survey outcomes are poised to provide a robust foundation for decision-making, policy formulation, and the harmonious coexistence of both humans and their canine companions within the urban landscape.

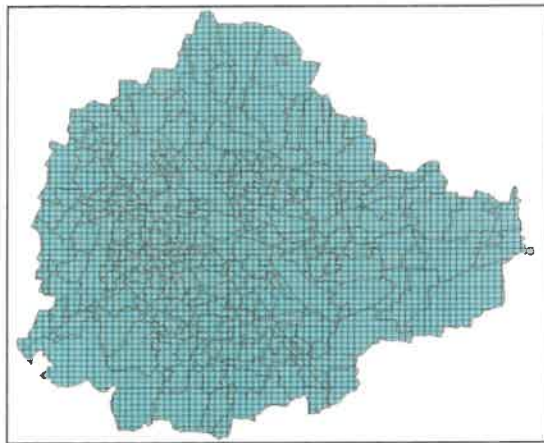


BBMP Zonal Map

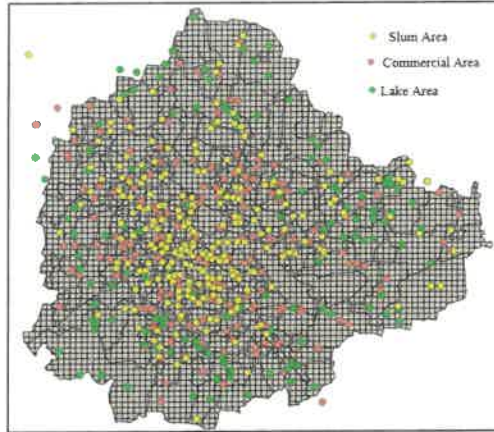


BBMP Ward wise Map

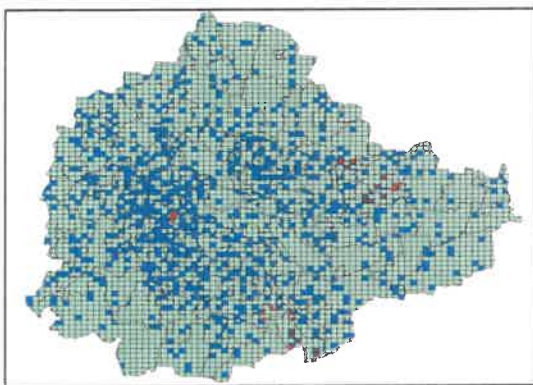
Figure 1. Study area showing 8 zones and 243 wards of BBMP in Bengaluru Urban district of Karnataka State



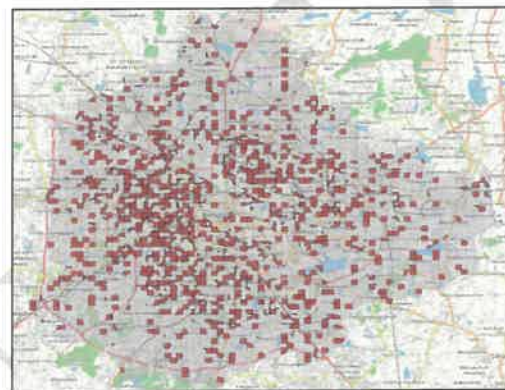
a. BBMP Gridded Map



b. BBMP Map with Lakes, Slums and Commercial



c. BBMP Sampling area Map



d. View of sampling points on open street map in QGIS

Figure 2. Study area showing BBMP gridded map, demarcated map with lakes, slums & commercial area, sampling area, and view on open street map

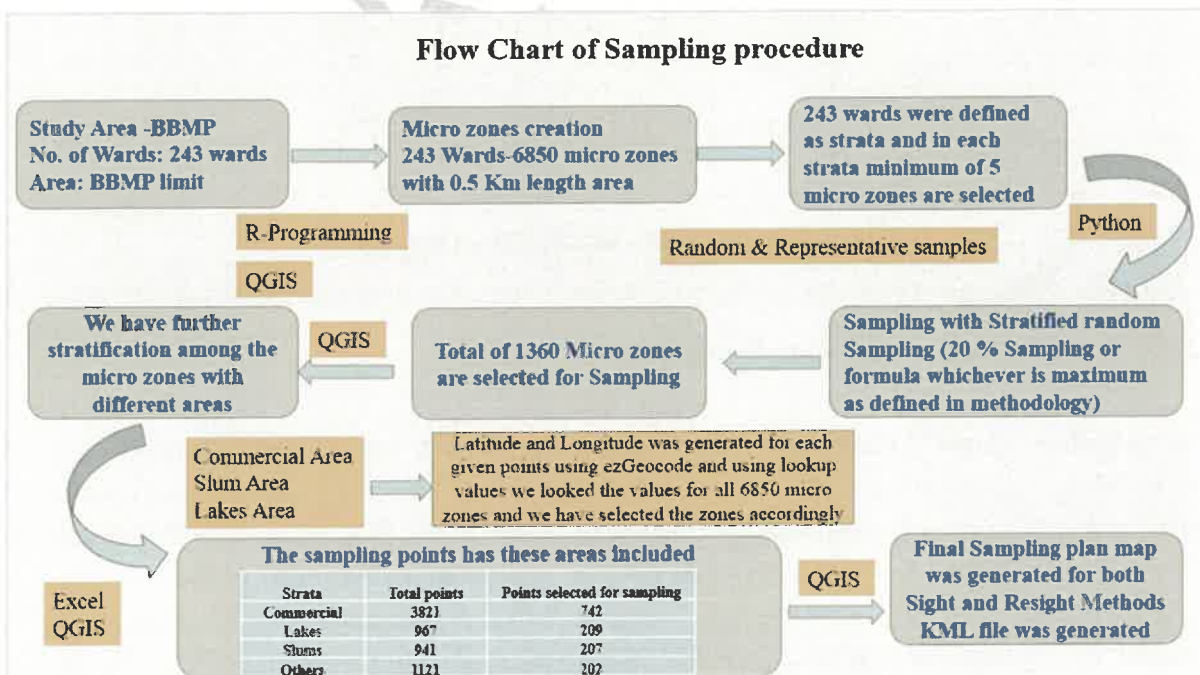


Figure 3: Flow chart of Sampling (Stratified Random Sampling) procedure

2.3. Mode of Survey

2.3.1 Single-Sight and Sight –Resight survey

The Single-Sight and Sight-Resight Survey was conducted within the BBMP limits over twelve days. For the first six days, single-sight survey was carried out for gathering information about the number of dogs in a particular area by a pair of surveyors by travelling down every road on a 2-wheeler, taking photographs and recording information about dogs seen in all parts of an allocated zone and also recording details of every dog they saw. On the next six days, all of the dogs seen on the first six days are recorded, whether or not, they were captured as seen on the first six days. This proportion makes it possible to estimate the total dog population for the region using Lincoln–Petersen’s formula given below

Unlike the Single-Sight Survey method, the SRS Survey method provides an estimate of the total population in the surveyed area, however, they require more staff expertise and time to implement, limiting the area, which can be covered. Therefore, a combination of both SS and SRS surveys makes it possible to benefit from both scale and intensity of method.

2.3.2.2 Lincoln–Petersen’s Formula with Chapman’s Correction for population estimation

The sizes of the Street Dog populations were estimated using the Lincoln–Petersen formula with Chapman’s correction according to Equation in which N is the estimate of the total population size, n_1 is the total number of dogs marked during single sight survey, n_2 is the total number of dogs sighted during Sight–Resight survey, and m is the number of marked dogs re-sighted Sight–Resight survey. An approximate unbiased variance of N was estimated by using Seber’s formula. The 95% confidence interval for N was estimated according to Equation

$$N = \left[\frac{(n_1 + 1)(n_2 + 1)}{m + 1} - 1 \right]$$

$$\text{var}(N) = \left[\frac{(n_1 + 1)(n_2 + 1)(n_1 - m)(n_2 - m)}{(m + 1)^2(m + 2)} \right]$$

$$95\% \text{ confidence interval (CI)} = N \pm 1.965\sqrt{\text{var}(N)}$$

2.4. Survey Execution and Data Collection

The execution of the BBMP Street Dog Survey involved a meticulously planned operational methodology, structured to ensure accuracy and reliability. The survey was conducted across 1360 micro zones to capture a comprehensive snapshot of the Street Dog population in Bengaluru. Dr Chandraiah.T, Deputy Director (AH), BBMP was appointed as the nodal officer for Street Dog estimate survey 2023. Seventy-nine Para veterinarians of department of AHVS, Bengaluru Urban District and 30 Para veterinarians of BBMP (AH) were drafted to carry out the Street Dog estimate survey 2023. 15 Veterinary Officers of AH, BBMP were deputed to supervise the zone wise teams.

Once the human resources were arranged, a preliminary meeting was conducted on 03/05/2023 at ICAR NIVEDI to discuss the plan and course of action to be followed. Dr. K.P.Suresh, Principal Scientist (Biostatistics), ICAR-NIVEDI and Dr. Divakar Hemadri Principal Scientist, ICAR-NIVEDI agreed to provide the Design of Sampling plan for the Dog survey estimate including Analysis and Report.



Pic 1: Images of meetings conducted at ICAR-NIVEDI to discuss Sampling Methodology

WVS (Mission Rabies) agreed to provide technical support through its WVS mobile application. Street Dog estimate survey 2023 committee was formed to oversee the logistics, to coordinate and to carryout the Street Dog survey program in a transparent manner.

Introduction to WVS

Worldwide Veterinary Service - Mission Rabies is a non-profit organisation working in several rabies-endemic locations to control canine rabies in tandem with the global and national target to end canine-mediated human rabies by 2030, in addition, to improve the welfare of animals and promoting animal health worldwide. Our work has been well known and recognised by several public health and Govt. bodies namely; Govt. of Goa, NCDC, WHO, OIE and CDC.

Mission Rabies is developing effective approaches to mass dog vaccination and supporting other organisations through training and capacity building - protecting both the human and canine populations. Crucially, it's working. Human deaths in our key project sites have all but been eliminated and we'll keep going until it's zero all around the world.

Our flagship project Goa in association with the Government of Goa: There have been no human deaths from rabies for over 5 years now due to the combined efforts of the Government of Goa and Mission Rabies. In 2021 Goa was declared to be the first state in India to be a 'Rabies Controlled Area' under the Prevention and Control of Infectious and Contagious Diseases in Animals Act, 2009. The 3 main strategies were implemented to effectively control the disease - Mass dog vaccination (MDV), Community education about rabies and Enhanced rabies surveillance.

Bengaluru, in association with BBMP (Bruhat Bengaluru Mahanagara Palike): BBMP is an administrative body responsible for civic amenities and infrastructural facilities of the Greater Bengaluru Metropolitan area actively involved in providing healthcare, Street Dog population management, and maintaining public health.

In 2019, we collaborated with BBMP to conduct a scientific estimation of the dog population using the WVS data collection App. The survey estimated 309,975 free-roaming dogs within the limits of BBMP. Mission Rabies is working in collaboration with BBMP, the WOAHS Reference Rabies Diagnostic Laboratory, Animal welfare organisations and other key stakeholders in the city to strengthen the efforts to control rabies.

WVS provide technical support in terms of technology, capacity building, and monitoring of field operations, enabling effective data collection.

WVS Data Collection App:

First developed in 2014, it continues to be a powerful force for WVS and other organizations to conduct efficient field programs to benefit both animal welfare and operational impact. The WVS App is designed to collect effective geo-spatial data and management of large team size which helps in effective field implementation of Mass dog vaccination, ABC program and Surveys at large. The app has been used across the globe in our project sites as well as by many Government bodies and as a non-profit organization. We have enabled technology free of cost with our tech support to Governments.



Login Page



Menu Page

Map Assigned

Dog Details

Path Tracker



Sync Data

Training and capacity building :

A team of 100 surveyors were trained in 4 sessions to effectively collect the data using the WVS data collection application, according to the methodology provided by NIVEDI, SOPs of the dog estimate survey and general bias to be avoided during the field survey were conveyed during the training.

- Two rounds of training were delivered, one session a week before the survey and one a day before the survey.
- The training focused on data collection by using the WVS data collection app.
- Key data points included the gender of the dog, neuter status, Age of the dog
- The general SOP for the survey was discussed to reduce the bias during data collection.

WVS (Mission Rabies) team headed by Dr Balaji Chandrashekar created Team Wise User ID - Password and allotted the respective micro zones in the WVS app. This mobile application app

for Street Dog population survey directed the surveyors to specific micro zone. A hands on WVS app training was given to the survey teams on 23/05/2023 and on 03/07/2023.

A meeting of the Street Dog estimate survey 2023 committee was conducted on 09/06/2023 under the chairmanship of Honourable Special Commissioner (health and AH), BBMP to review the plan and course of action. Under the guidance of WVS team, Dr Chandraiah T, Nodal officer and Dr. S.M. Manjunath Shinde Assistant Director (AH) BBMP, conducted a pilot study on 16/06/2023 and 21/06/2023 to ascertain the survey timing and the total of number micro zone that can be surveyed within the given time and to find out any short comings of the WVS app. It was finalized that the ideal time to carry out the survey was 6.00AM to 8.30AM and a total number 05 micro zones can be surveyed within that time.

The survey involved Single-Sight and Sight-Resight Survey method conducting surveys of the selected 1360 micro zones over twelve days by a total of 50 teams. Each team consisted of a pair of surveyors surveyed the allocated 05 micro zones per day travelling on a 2-wheeler bike and recording details of every dog they see. Each team was assigned to carry out the survey in 05 wards. Team members were selected based on their locality and nearby wards so that they would reach the survey micro zone on time and complete the survey of assigned micro zone within 6.00AM to 8.30AM. A final WVS app training was given to the finalized survey teams and supervisors in two batches on 03/07/2023. The date for Street Dog estimate survey 2023 was finalized as from 11/07/2023 to 24/07/2023.

2.4.1. Single Sight and Sight-Resight:

- a) The initial phase, termed the "Single Sight," spanned from July 11th, 2023, to July 18th, 2023. The subsequent phase, referred to as the "Sight-Resight," took place from July 19th, 2023 to July 27th 2023.
- b) These two phases focused on thorough data collection from a total of 1360 micro zones that spanned across the 243 wards.
- c) A deployment of 50 survey teams effectively covered each of the 243 wards

2.4.2 Resight for Recapture count (m) standardization:

- a) A crucial aspect of the survey involved calculating the "m value," a parameter used in population estimation.
- b) The resight phase for calculating the "m value" was conducted over two days, specifically on July 31st, 2023, and August 2nd, 2023.
- c) For this phase, 24 micro zones from 12 wards were revisited the purpose was to capture additional visual data of street dogs to aid in calculating the "m value."

The resight survey phase for calculating m value, a crucial element of the BBMP Street Dog Survey, was conducted meticulously over two days, involving a total of 12 dedicated teams. During the resight survey, each of the 12 teams revisited the same locations on both days, capturing photographs of street dogs present in the designated micro zones. These photographs,

taken on both days, were subjected to a meticulous individual assessment for similarity. This process involved comparing the photographs from each day to identify common street dogs that appeared in both sets of images. The evaluation for similarity ensured that each street dog's identity was carefully cross-referenced across the two sets of photographs. This step was crucial to eliminate duplications and ensure that the "m value" calculation was based on an accurate count of unique individuals.

Based on the outcome of this detailed analysis, the "m value" was calculated for the 24 specific micro zones that were revisited during the resight survey. These meticulously calculated "m values" for the sampled micro zones served as a reliable foundation for estimating the "m value" for the remaining zones, a methodology that enhances the precision and credibility of the population estimation process. The rigorous approach of cross-referencing and calculating "m values" for a subset of micro zones, followed by extrapolation to the entire dataset, underlines the survey's commitment to accuracy and reliability.



Pic 2: Images of meetings conducted at BBMP to discuss Sampling Methodology and Demo of the methodology

Stray dogs survey in city from today

The Hindu Bureau
BENGALURU

The city civic body has launched a stray dog survey across the city, which will be conducted over the next 14 days. The last such survey was done in 2019, when it pegged the stray dog population in the city at 3.1 lakh.

"A resurvey is being taken up to assess the success of Animal Birth Control (ABC) programme and anti-rabies vaccine programme from 2019," Chief Civic Commissioner Tushar Giri Nath said.

The 840 sq.km area under Bruhat Bengaluru Ma-



The 840 sq.km area under BBMP has been divided into 6,850 micro-zones of 0.5 sq.km area each, of which a random sampling of 20%, or 1,350 micro-zones, have been selected for the survey. FILE PHOTO

hanagara Palike (BBMP) has been divided into 6,850 micro-zones of 0.5 sq.km area each, of which a random sampling of

20%, or 1,350 micro-zones, have been selected for the stray dog survey, the BBMP said. Care has been taken to ensure these micro-zones selected include all kinds of areas like residential, commercial and industrial ones, sources said.

The exercise will be led by K.P. Suresh, Chief Scientist (Biostatistics), Indian Council of Agricultural Research - National Institute of Veterinary Epidemiology and Disease Informatics (ICAR-NIVEDI), Bengaluru. He will lead a team of 100 personnel drawn from Animal Husbandry Department, Government of Karnataka, and Animal

Husbandry Department, BBMP, who have been divided into 50 teams of 2 personnel each. The survey will be conducted from 6.00 a.m. to 8.30 a.m. everyday over the next two weeks. Each stray dog in the selected micro-zone will be photographed and their details entered in an in-house app.

Mr. Giri Nath said the survey will provide the civic body with not only the total number of stray dogs in the city, but also ward wise and zone wise numbers, male to female ratio and extent of implementation and success of ABC programme in the city.

ಬೀದಿನಾಯಿಗಳ ಲೆಕ್ಕಾಚಾರಕ್ಕಿಳಿದ ಪಾಲಿಕೆ

ಬಿಬಿಎಂಪಿ ಪ್ರತಿ ವಾರ್ಡ್‌ನಲ್ಲಿ 14 ದಿನಗಳ ಕಾಲ ಸಮೀಕ್ಷೆ, 50 ತಂಡ ರಚನೆ

ಬೆಂಗಳೂರು ಬಿಬಿಎಂಪಿ ಪರೀಕ್ಷೆ ಮತ್ತು ಸಾಂಯಗಳ ಲೆಕ್ಕಾಚಾರಕ್ಕೆ ಸಜ್ಜಾಗಿದೆ. ಪಾಲಿಕೆ ವ್ಯಾಪ್ತಿಯಲ್ಲಿ ಮಂಗಳವಾರದಿಂದ ಬೀದಿ ನಾಯಿಗಳ ಸಮೀಕ್ಷೆಯು ಆರಂಭವಾಗಲಿದ್ದು ಪ್ರತಿ ವಾರ್ಡ್‌ಗಳಲ್ಲಿ ಸಮೀಕ್ಷೆ ನಡೆಯಲಿದೆ. 14 ದಿನಗಳ ಸಮೀಕ್ಷೆಯ ನಂತರ ಒಟ್ಟಾರೆ ಐ.ಕೆ.ಸಿ. ಸುರೇಶ್ ಕಡತಕ್ಕೆ ತಂದ ಪಾಲಿಕೆಗೆ ಬೀದಿನಾಯಿಗಳ ಒಟ್ಟು ಸಂಖ್ಯೆಗಳ ಪರಿಚಯವಾಗಲಿದೆ.

ಬೀದಿ ನಾಯಿಗಳ ಸಂಖ್ಯೆ ನಿಯಂತ್ರಣ ಹಾಗೂ ಪ್ರಾಣಿವೈದ್ಯಕೀಯ ರೋಗವಾರ್ಡ್ ರೋಗ ರೋಗಿಗಳ ಬೀದಿ ನಾಯಿಗಳಲ್ಲಿ ಸಂಭವಿಸಬಹುದಾದ ತಕ್ಷಣಕ್ಕೆ ಮತ್ತು ಅಂತಿಮವಾಗಿ ಲಿಖಿತ ಕಾರ್ಯಕ್ರಮವನ್ನು ಪಾಲಿಕೆಯ ಪರವಾನಗಿಯ ವಿಧಾನ ಕೈಗೊಂಡಿದೆ. 100ಕ್ಕೂ ಅಧಿಕ ಮಂದಿ ಬೀದಿ ನಾಯಿಗಳ ಸಮೀಕ್ಷೆಯಲ್ಲಿ ತೊಡಗಲಿದ್ದಾರೆ. ಪಾಲಿಕೆಯ 6850 ವಾರ್ಡ್‌ಗಳಲ್ಲಿ ವ್ಯವಸ್ಥಿತವಾಗಿ ಬೀದಿ ನಾಯಿಗಳ ಸಮೀಕ್ಷೆ ನಡೆಯುವ ಹಿನ್ನೆಲೆಯಲ್ಲಿ 50 ತಂಡಗಳನ್ನು ಪಾಲಿಕೆ ರಚಿಸಿದೆ.

ಈ ಹಿಂದೆ 2019ರಲ್ಲಿ ಪಾಲಿಕೆ ವ್ಯಾಪ್ತಿಯಲ್ಲಿ ಬೀದಿ ನಾಯಿಗಳ ಸಮೀಕ್ಷೆಯನ್ನು ಮಾಡಿದ್ದು 1.10 ಲಕ್ಷ ಬೀದಿ ನಾಯಿಗಳ ಸಂಖ್ಯೆಯನ್ನು ಕಂಡು ಬಂದಿತ್ತು. ಪಾಲಿಕೆಯ ಎಲ್ಲಾ ವಲಯಗಳಲ್ಲಿ ಸಂಶೋಧನಾ ತಂಡ ತುರ್ತು ಪಡೆದು ಸಮೀಕ್ಷೆಗೆ ಆರಂಭಿಸಿದೆ. ಲಿಖಿತ ಕಾರ್ಯಕ್ರಮವನ್ನು 2019ರಲ್ಲಿ ಸುರೇಶ್ ಕಡತಕ್ಕೆ ತಂದಾಗಿನ ನಂತರವಾಗಿಯೇ ನಡೆಯುತ್ತಿದೆ.

ಡಾ.ಕೆ.ಸುರೇಶ್, ಡಾ.ಹೆಮಂತಿ ದೀಪಾಳ,



ಡಾ.ಶಿಲ್ಪಾ ನನ್ನಯ್ಯ, ಡಾ.ಬಾಲಾಜಿ ಚಂದ್ರಶೇಖರ್ ಅವರಿಂದ ಪ್ರವಾಸ ವಿಜ್ಞಾನಿಗಳ ತಂಡದ ಜೊತೆ ಬೆಂಗಳೂರು ನಗರ ಜಿಲ್ಲೆಯ ಅರಣ್ಯಾಂತರಾಜ್ಯದ ಸೀತಾ ಬೀದಿ ನಾಯಿಗಳ ಸಮೀಕ್ಷೆ ಕಾರ್ಯಕ್ರಮದ ಕೊಡುಗೆಗಳಿಗಾಗಿ ಪರಿಶಿಷ್ಟತೆಯ ವಿಧಾನಗಳ ಸ್ವೀಕರಣದ ಕೊಡುಗೆಗಳನ್ನು ಕೊಡಲಾಗುವುದು.

50 ತಂಡ ರಚನೆ: 840 ಚ.ಕಿ.ಮೀ ವ್ಯಾಪ್ತಿಯಲ್ಲಿ ಬಿಬಿಎಂಪಿಯನ್ನು (ವಾಣಿ ಪ್ರದೇಶ, ಕೊಳೆ ಪ್ರದೇಶ, ಮಣ್ಣು ಪ್ರದೇಶ ಹಾಗೂ ಕೆರೆಗಳು) 0.5 ಚ.ಕಿ.ಮೀ ವ್ಯಾಪ್ತಿಯ 6850 ಮೈಕೀಟಾ ವಿಸ್ತಾರ ಗಳನ್ನು ವಿಂಗಡಿಸಲಾಗಿದೆ. ಅದರಲ್ಲಿ 207 ತಂಡ ರಚನೆಗೆ ವ್ಯವಸ್ಥೆಗಳು ಅಂದರೆ 1,360 ಮೈಕೀಟಾ ವಿಸ್ತಾರ ಗಳಲ್ಲಿ ಸಮೀಕ್ಷೆ ಮಾಡಲು ಅವಕಾಶವಾಗುವುದು. ಬೆಂಗಳೂರು ನಗರ ಜಿಲ್ಲೆಯ ಬಹುಪಾಲು ವಿಸ್ತಾರ ಹಾಗೂ ಪರಿಶಿಷ್ಟತೆ ಸಹಜ ಕಾರಣವು 70 ಅರಣ್ಯಾಂತರಾಜ್ಯ

ಬೀದಿ ನಾಯಿಗಳ ಸರ್ವೇ ಹೇಗೆ ನಡೆಯಲಿದೆ?

ಬಿಬಿಎಂಪಿ ಸಮೀಕ್ಷೆ 14 ದಿನಗಳ ಕಾಲ ಪ್ರತಿದಿನ ಬೆಳಿಗ್ಗೆ 6 ಗಂಟೆಯಿಂದ 8 ಗಂಟೆಯ ವರೆಗೆ ನಡೆಯಲಿದೆ. ಮೈಕೀಟಾ ವಿಸ್ತಾರಗಳಲ್ಲಿ ಕಂಡು ಬರುವ ಬೀದಿ ನಾಯಿಗಳ ಲೆಕ್ಕಾಚಾರಕ್ಕಾಗಿ ಪ್ರತಿ ನಾಯಿಯು ಮುಖವನ್ನು ತೆಗೆದುಕೊಂಡು ಫೋಟೋ ತೆಗೆದುಕೊಳ್ಳಲಾಗುವುದು. ಫೋಟೋ, ನಾಯಿಯ ಮುಖವನ್ನು ಮುಚ್ಚಿ ಕೊಡುವುದು, ನಾಯಿಯನ್ನು ಮುಚ್ಚಿ ಕೊಡುವುದು, ಒಟ್ಟು 14 ದಿನಗಳ ಸಮೀಕ್ಷೆಯ ನಂತರ ಒಟ್ಟಾರೆ ಐ.ಕೆ.ಸುರೇಶ್ ಕಡತಕ್ಕೆ ತಂದ ಪಾಲಿಕೆಗೆ ಬೀದಿನಾಯಿಗಳ ಸಂಖ್ಯೆಗಳ ಪರಿಚಯವಾಗಲಿದೆ.

ಸ್ವಲ್ಪದ ಹಾಗೂ ವಾರಿಯು ಮುಖವನ್ನು ತೆಗೆದುಕೊಂಡು 10 ಸ್ವಲ್ಪದ ಕೊಡುಗೆ 100 ಮಂದಿಯ ಮೂಲಕ ಈ ಸಮೀಕ್ಷೆಯಲ್ಲಿ ಪಾಲ್ಗೊಳ್ಳಲಿದ್ದಾರೆ. ಬೀದಿ ನಾಯಿ ಸಮೀಕ್ಷೆಯನ್ನು ಕ್ರಮಬದ್ಧವಾಗಿ ವ್ಯವಸ್ಥಿತವಾಗಿ ಮಾಡುವ ನಿರೀಕ್ಷಿಸಲಾಗಿದೆ. 1 ತಂಡದಲ್ಲಿ ಕಲ್ಯಾಣ ಸಮೀಕ್ಷಾಧಿಕಾರಿಗಳು ಒಟ್ಟು 50 ತಂಡಗಳನ್ನು ರಚಿಸಲಾಗಿದ್ದು, ಅದರ ಮೈಕೀಟಾ ವಿಸ್ತಾರವಾಗಿ 15 ಮೈಕೀಟಾ ವಿಸ್ತಾರವನ್ನು ನಿರೀಕ್ಷಿಸಲಾಗಿದೆ.

Canine countdown: 50 teams get cracking

Team to scour 1,360 microzones; surveyors will put on record each dog they see

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The Bruhat Bengaluru Mahanagara Palike (BBMP) initiated its much-awaited comprehensive dog census in Bengaluru, starting on July 11, with 50 teams of experts scouring through 1,360 microzones of BBMP's limit.

The survey will span all 24.5 wards of BBMP and will cover 166.7 square kilometres out of the total 840 square kilometres area. The enumerators include 70 officials from the Department of Animal Husbandry and Veterinary Services and 40 officials from BBMP's Animal husbandry department.

The sight-recognise study will involve a pair of surveyors travelling on a two-wheeler through all parcels of allocated microzones and recording details of every dog they see. The final number will be extrapolated to estimate the total number of street dogs in Bengaluru.

"If no rain, the survey will start on Tuesday morning with 50 teams, it all goes well and the weather permits, the survey will be completed by the end of July and we will have the results by mid-August. Drone technology will be used on a pilot



basis for such kind of survey for the first time across the country. We are looking forward to the outcome," said KP Ravikumar, Joint Director, BBMP's Animal Husbandry Department.

Of 1,360 microzones identified by researchers, 772 are in commercial areas of the city, 209 are around lakes, 207 are slum areas and 172 microzones have been classified as others.

After a gap of five years, the survey results will help analyse the efficacy of the ongoing ABC/ARY program by the civic agency. The last survey done to estimate the total number of street dogs in Bengaluru was conducted in 2019, recording 3.1 lakhs stray dogs. Before that, 1.85 lakhs dogs were recorded in the 2012 survey and 1.83 lakhs in the 2007 survey.

"By understanding the size of the stray dog population, we will be able to allocate resources more efficiently and plan strategies accordingly. Areas with a high prevalence

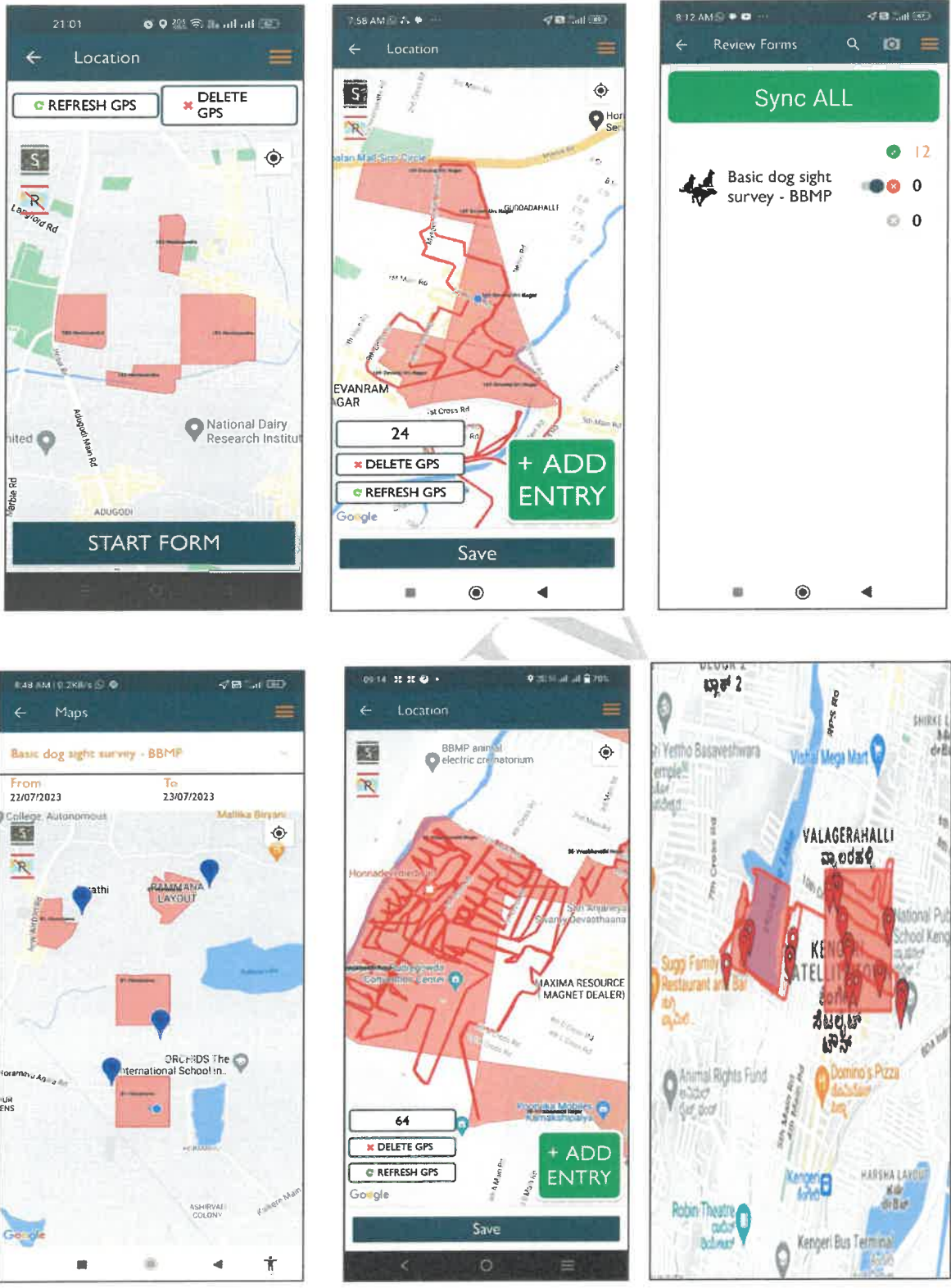
of stray dogs will be managed differently and help us improve animal welfare activities too," said a senior official from BBMP's Animal Husbandry department.

Each team will be allotted four microzones per day and every team will survey 28 zones for the first seven days, sighting the stray dogs in the given areas. The given teams will go around the same 28 microzones over the next seven days, resighting the stray dogs and entering the data in the WVS application.

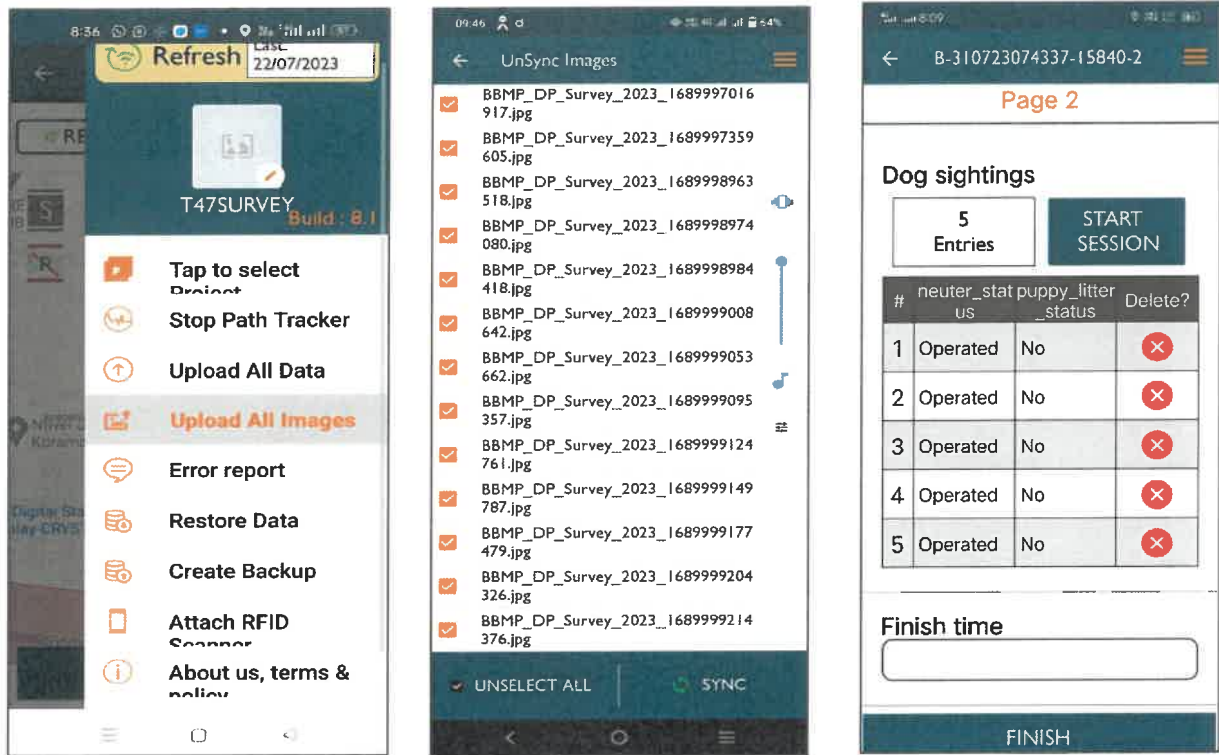
Data recorded in the survey application will include information such as male or female, female lactating or not lactating, number of puppies, and neutered or unneutered dogs.

The sampling methodology for the survey has been formulated by scientists from the National Institute of Veterinary Epidemiology and Disease Informatics, Indian Council of Agricultural Research (ICAR-NIVEDI).

Pic 3: Spotlight on Street Dog Survey: BBMP's Comprehensive Efforts Garner Attention in Newspaper



Pic 4: Operational Perspective of the Survey: Allocated Grids, GPS Mapping of Survey Zone and Image Upload to the Application (WVS)



Pic 5: Selection of Choices for Image Uploading and Synchronization of Visuals to App



Pic 6: Few Images of Canines Documented Throughout the Survey



Pic 7: Photographs of Gatherings for Deliberation on Survey Progression with Enumerators and Supervisors

2.5 Exploring Innovative Approaches: Drone Technology in Survey

The success of the BBMP Street Dog Survey was greatly enriched by a strategic partnership with VayDyn, a pioneering startup situated at ARTPARK, IISc. VayDyn's expertise in drone technology, platform development, and AI-analytics brought a revolutionary dimension to the survey's operations. In a bid to augment the survey's capabilities and explore innovative methodologies, the BBMP Street Dog Survey incorporated drone technology into its operations. Specifically, drone technology was employed in selected lakes, aiming to gauge its effectiveness in enhancing dog population assessments and data collection.

2.5.1 Drone-Assisted Lake Surveys:

In a strategic move, drone technology was deployed to conduct surveys in specific lakes within the survey area. Drones were employed to capture high-resolution aerial imagery of these lakes, providing an elevated perspective of the surroundings. This approach enabled the survey team to efficiently scan larger areas, potentially offering insights into dog populations in and around these lakes.

2.5.2 Benefits and Potential:

The incorporation of drone technology introduced several advantages to the survey process. By providing a unique vantage point from above, drones offered a broader overview of the surveyed areas, aiding in the identification and estimation of Street Dog populations. The technology also allowed for rapid data collection and the capture of images from angles that might be challenging to access on foot.

Additionally, the survey aimed to evaluate the feasibility of using drones for similar assessments in the future. This trial not only underscored the potential of drone technology in Street Dog population assessments but also opened avenues for further innovation and refinement of methodologies.

2.5.3 Considerations and Implications:

While the use of drone technology showcased promise in enhancing survey efficiency, it also raised considerations. Factors such as weather conditions, regulations, and the need for specialized operators were integral to the successful deployment of drones. Balancing these elements ensured that the survey's objectives were met effectively.

While the incorporation of drone technology marked a significant advancement in the BBMP Street Dog Survey, the traditional data collection methods continued to demonstrate their

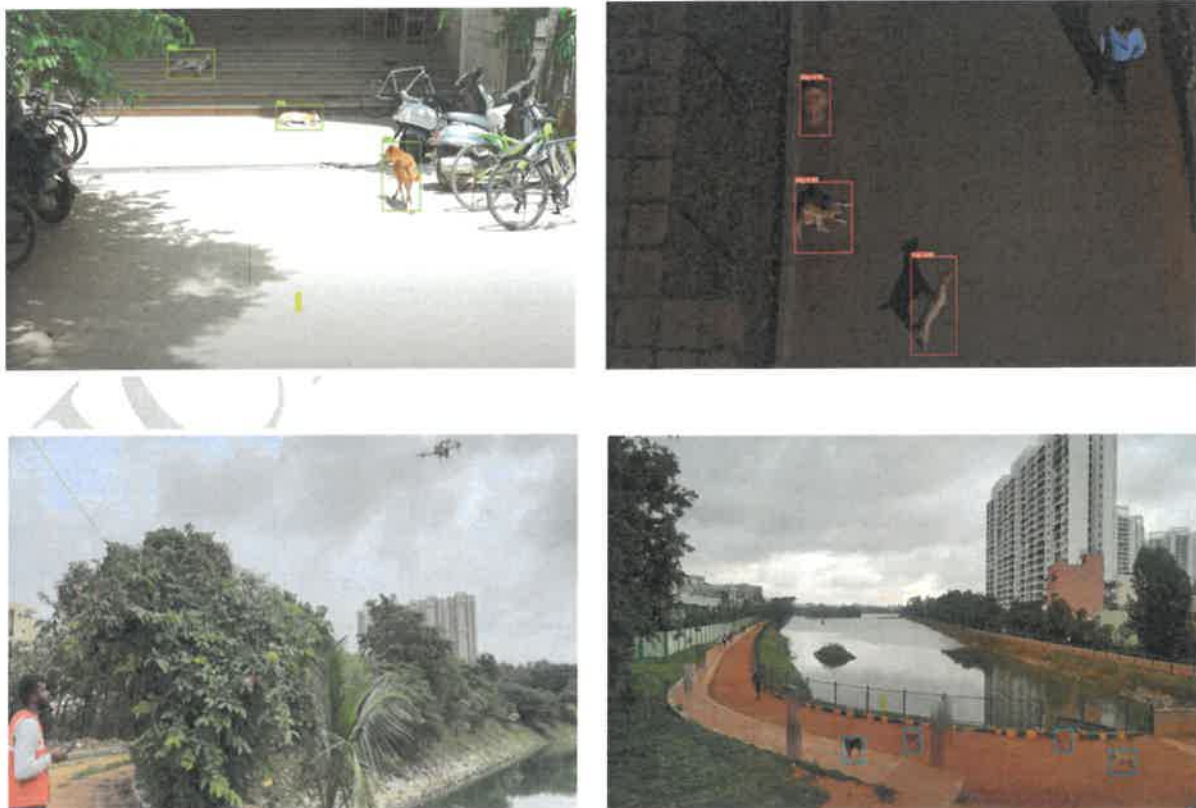
relevance and importance. Despite the capabilities of drones, the traditional approach held its ground due to its ability to capture essential information beyond mere numbers.

The traditional survey method, executed by survey teams on foot, allowed for a comprehensive assessment that extended beyond population counts. Enumerators, through direct observation, gathered critical details such as gender, age, and neutering status of Street Dogs. These nuances offered a deeper understanding of the population's demographics and provided valuable insights for subsequent analysis.

2.5.4. Balancing Innovation with Tradition

The BBMP Street Dog Survey's ability to integrate both innovative drone technology and traditional methods showcased a balanced approach that respected the strengths of each approach. The survey's adaptability in combining these methodologies exemplified its commitment to thoroughness, accuracy, and a holistic understanding of the Street Dog population dynamics.

In conclusion, while drone technology introduced a new dimension to the survey, the traditional data collection methods proved to be a vital asset in capturing essential details. This harmonious integration of innovation and tradition underscored the survey's commitment to achieving a comprehensive and accurate portrayal of the Street Dog population in Bengaluru.



Pic 8: Operational Aspects and Canine Imagery in Drone Implementation

2.6 Statistical Exploration: Refinement of Raw Data, Categorization, and Comprehensive Analysis

The process of statistical analysis within the BBMP Street Dog Survey was a methodical journey that began with the refinement and categorization of raw data. Once the data was meticulously cleansed and imputed, the analysis was systematically undertaken, encompassing various stages.

2.6.1. Descriptive Statistics

Initial analysis focused on descriptive statistics, providing a clear overview of the data's characteristics. This phase served as a foundation for the subsequent in-depth analyses.

2.6.2. Gridded Data Sorting and Categorization

The gridded data underwent a systematic sorting process based on latitude and longitude. Subsequently, the assignment of categories corresponding to specific latitude and longitude ranges was executed. This categorization enabled the calculation of populations within distinct categories.

2.6.3. Ward wise and Zonal Analysis

The analysis extended from ward wise evaluations to comprehensive zonal assessments. The progression from micro-level insights to a broader zonal perspective facilitated a holistic understanding of the Street Dog population dynamics.

2.6.4. Recapture count (m) standardization and Population Estimation

Meticulous calculations of the "m value" were pivotal in estimating the Street Dog population. The process began with the calculation of the "m value" for 24 select micro zones, subsequently extrapolating to all micro zones. These calculations were fundamental in deriving the overall population estimation for all zones. The computation of variance and the establishment of a 95% confidence interval added robustness to the estimates.

2.6.5. Sample Estimation and Distribution Analysis

The scope extended to sample estimation, focusing on the distribution of Gender, neutering status and age within the population. This phase aimed to unveil insights into key demographic attributes.

3. Population and Sample Estimation Results

The implementation of the BBMP Street Dog Survey involved a systematic sampling strategy that encompassed the division of the survey area into wards, the introduction of micro zones, and the careful selection of specific blocks for analysis. This section sheds light on the details of this strategic approach and its implications for the survey outcomes.

3.1.1 Population estimation insights

The population estimation results for micro zones, as summarized in the table below, offer a comprehensive overview of the Street Dog population dynamics in the surveyed area. The data

reflects the calculated population estimates for both 1360 and 6850 micro zones, shedding light on the distribution and magnitude of the Street Dog population.

Table1: Population estimation for Micro zones with confidence interval

	No of dogs Sighted on Single Sight survey	No of dogs Sighted on Sight-Resight survey	m value	Total Population	95% CI
1360 Micro zones	19,395	20,008	6,996	55,465	54625-56305
6850 Micro zones	97,674	1,00,760	35,232	2,79,335	277450-281220

Following the meticulous estimation process conducted within the BBMP Street Dog Survey, a projected total Street Dog population of approximately 279335 was derived for the surveyed area. This estimation is accompanied by a 95% Confidence Interval (CI), offering a range within which the actual population is likely to fall.

The following table of the represents a detailed breakdown of the zone-wise total Street Dog population estimates, complemented by their corresponding 95% Confidence Intervals (CI).

Table 2: Zone wise Total Population estimates with CI, Gender population estimates and percentage status of neutered

Zones	Total Population	95% Confidence Interval (CI)	Gender population			Neutered (%)
			Male	Female	Unknown	
Bengaluru East	37685	36993-38377	21584	11228	4873	71.75
Bommanahalli	39183	38475-39891	23860	9299	6024	72.18
Bengaluru South	23241	22692-23790	13116	7066	3059	77.32
Bengaluru West	22025	21493-22557	13870	6261	1894	79.48
Dasarahalli	21221	20700-21742	14580	4850	1791	77.46
Mahadevpura	58371	57513-59229	32528	18872	6971	59.34
R R Nagar	41266	40541-41991	24638	11899	4729	67.64
Yelahanka	36343	35679-37007	21165	13282	1896	66.50
Total	279335	277450-281220	165341	82757	31237	71.81

The figures within the table illuminate the variations in Street Dog populations across various zones within the surveyed area. Each zone's total population estimate provides insights into the localized dynamics of Street Dog presence.

Zone Wise Estimated Street Dog Population

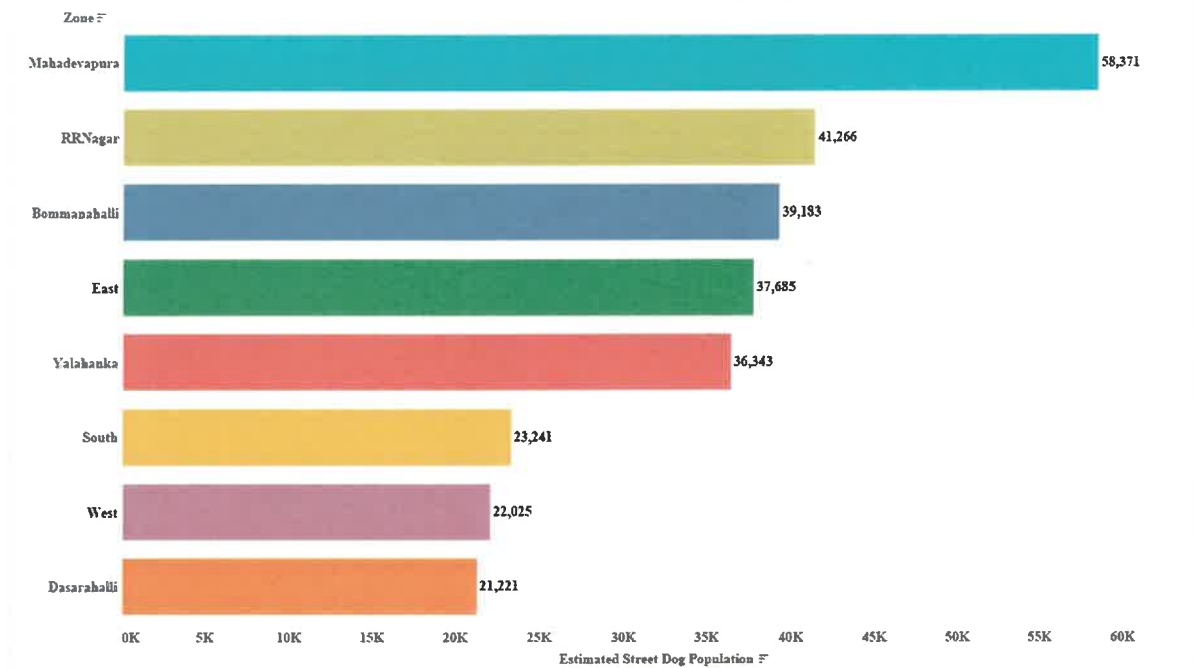


Figure 1: Zonal Street Dog estimated population distribution

The Table 3 of the presents a comprehensive breakdown of the Street Dog population estimates in each of the strata such as Commercial Areas, Lakes, Slums and Others. This segmentation provides a deeper insight into the distribution of Street Dog populations in relation to specific urban contexts.

Table 3: Street Dog Population by Categories and Confidence Intervals

Categories	Total Population	95% Confidence Interval	Total points	Sample points	Total Points (%)
Commercial	155684	154286-157082	3821	742	55.78
Lakes	21408	20933-21883	967	209	14.11
Slums	12783	12429-13137	941	207	13.73
Others	89460	88396-90524	1121	202	16.38
Total	279335	277450-281220	6850	1360	100

Table 4 presents a comprehensive overview of the Street Dog population estimates across the 243 surveyed wards within Bengaluru. This tabulation provides a vital snapshot of the Street Dog dynamics at the ward level, enhancing our understanding of localized variations in canine presence. Each row in the table represents a specific ward, while the corresponding figures reflect the estimated Street Dog population within that ward.

Table 4: Ward wise Street Dog Population and 95% Confidence Intervals with gender population and neutered percentage

Sl.No	Ward	Ward Number	Total Population	95 % CI	Gender population			Neutered (%)
					Male	Female	Unknown	
1	Horamavu	81	8365	8047-8683	3453	3012	1900	73.09
2	Jakkuru	8	7921	7914-7928	4453	2858	610	58.27
3	Hemmigepura	35	6856	6576-7136	4026	2810	20	55.61
4	Varthuru	112	6256	6024-6488	2889	2789	578	64.74
5	Dodda Bidarakallu	28	4911	4706-5116	3570	803	538	58.78
6	Begur	227	4587	4363-4811	3063	780	744	60.57
7	Kalena Agrahara	226	4455	4223-4687	2691	1570	194	62.78
8	Nelagadderanahalli	23	4186	3968-4404	3106	714	366	82.06
9	Shettihalli	17	4144	3919-4369	2139	965	1040	75.35
10	Kadugodi	104	3943	3725-4161	1470	838	1635	57.68
11	Rajarajeshwari Nagar	49	3929	3734-4124	1836	1454	639	55.71
12	Kempegowda Ward	1	3916	3701-4131	2052	1630	234	57.39
13	Anjanapura	224	3856	3665-4047	2294	1260	302	58.68
14	Ullal	32	3624	3414-3834	2118	1314	192	59.96
15	Marathahalli	114	3582	3372-3792	2057	1238	287	64.65
16	Hudi	106	3393	3191-3595	1504	1340	549	49.54
17	Thanisandra	7	3391	3192-3590	1575	1430	386	46.21
18	Kogilu	6	3279	3095-3463	2300	920	59	84.1
19	Gottigere	225	3274	3074-3474	1434	256	1584	74.27
20	Dodda Nekkundi	108	3256	3057-3455	1687	1347	222	73.88
21	Chowdeswari Ward	2	3131	2973-3289	1898	1164	69	71.49
22	K R Puram	86	2853	2670-3036	2404	232	217	50.77
23	Bellanduru	115	2825	2666-2984	1157	1137	531	81.1
24	Agaram	180	2692	2559-2825	1486	965	241	65.481
25	Basavanapura	88	2683	2503-2863	1993	669	21	56.52
26	Doddagollarahatti	31	2643	2489-2797	1348	423	872	65.29
27	Atturu Layout	4	2614	2437-2791	1821	771	22	69.18
28	Chokkasandra	22	2415	2247-2583	1618	726	71	70.02
29	Byatarayanapura	11	2390	2276-2504	1459	812	119	66.34
30	Hennur	94	2348	2188-2508	1791	274	283	81.74
31	Banasavadi	100	2289	2122-2456	1261	976	52	50.93
32	Whitefield	110	2210	2056-2364	1286	900	24	63.99
33	Bilekhalhi	237	2193	2032-2354	1218	952	23	72.36
34	Dodda Bommasandra	13	2154	2011-2297	1198	920	36	70.5
35	Aramane Nagara	60	2146	1997-2295	1472	500	174	74.34

Sl.No	Ward	Ward Number	Total Population	95 % CI	Gender population			Neutered (%)
					Male	Female	Unknown	
36	Naganathapura	228	2114	1957-2271	1746	178	190	68.26
37	Ramamurthy Nagara	84	2088	1931-2245	1603	464	21	35.35
38	Jnana Bharathi	48	2040	1911-2169	1045	376	619	57.93
39	Kammagondanahalli	16	1962	1809-2115	1125	820	17	56.4
40	Doddakanahalli	116	1857	1835-1879	994	841	22	59.5
41	Rajagopal Nagar	24	1838	1700-1976	1349	376	113	87.51
42	Hagadur	111	1803	1692-1914	1490	291	22	49.42
43	HSR - Singasandra	232	1785	1639-1931	1274	355	156	84.77
44	HAL Airport	93	1735	1683-1787	1358	360	17	59.11
45	Kuvempunagar	15	1734	1593-1875	1185	512	37	72.67
46	Vidyamanyanagar	29	1731	1594-1868	972	200	559	55.23
47	Agara	230	1726	1585-1867	1011	566	149	82.1
48	Kalkere	83	1712	1576-1848	752	508	452	53.41
49	Lal Bahadur Nagar	118	1710	1568-1852	249	354	1107	73.31
50	Kengeri	33	1700	1576-1824	883	798	19	66.96
51	Bagalakunte	18	1682	1542-1822	1236	412	34	76.39
52	Arakere	238	1671	1529-1813	645	96	930	72.23
53	Kempapura	10	1618	1482-1754	974	622	22	66.55
54	Veeramadakari	40	1602	1480-1724	1067	418	117	79.24
55	Herohalli	30	1599	1471-1727	783	229	587	51.78
56	Mahadevapura	90	1592	1455-1729	990	585	17	73.32
57	Belathur	105	1579	1559-1599	1050	453	76	47.24
58	Rupenaagrahara	233	1548	1413-1683	1383	121	44	80.3
59	Mallasandra	20	1494	1364-1624	1310	133	51	75.61
60	Konanakunte	221	1474	1342-1606	1023	346	105	65.6
61	Nalvadi Krishnaraja Wadior Park	47	1456	1326-1586	1019	394	43	56.94
62	Jayamahal	127	1435	1313-1557	619	578	238	72.74
63	Vishwanath Nagenahalli	68	1425	1293-1557	782	545	98	86.52
64	Koramangala	186	1358	1243-1473	605	533	220	78.71
65	Kodigehalli	12	1287	1179-1395	636	539	112	79.91
66	Vasanthpura	219	1281	1228-1334	808	320	153	69.71
67	Vijinapura	85	1258	1136-1380	749	492	17	72.19
68	Peenya	41	1251	1129-1373	1061	146	44	78.58
69	Vijayanagara Krishnadevaraya	45	1228	1108-1348	818	356	54	74.08
70	Bande Mutt	34	1226	1191-1261	689	520	17	67.89

Sl.No	Ward	Ward Number	Total Population	95 % CI	Gender population			Neutered (%)
					Male	Female	Unknown	
71	New Bayappanahalli	119	1217	1100-1334	1022	178	17	68.3
72	Garudachar Playa	107	1198	1080-1316	553	352	293	65.24
73	Jayachamarajendra Nagar	73	1164	1047-1281	550	479	135	68.74
74	New Thippasandra	122	1159	1060-1258	871	269	19	75.93
75	Hegganahalli	26	1149	1031-1267	804	326	19	73.96
76	Radhakrishna Temple Ward	66	1141	1026-1256	490	533	118	81.85
77	Shantala Nagar	181	1126	1021-1231	825	164	137	70.06
78	Devasandra	89	1098	986-1210	865	216	17	73.94
79	Ranadheera Kanteerava	43	1098	990-1206	854	227	17	80.08
80	C V Raman Nagar	117	1081	974-1188	671	393	17	82.73
81	Kudlu	243	1081	981-1181	882	131	68	63.93
82	Mangammanapalya	231	1076	962-1190	634	332	110	73.82
83	Hulimavu	239	1044	939-1149	457	22	565	54.68
84	Byrasandra	196	1043	963-1123	757	265	21	70.56
85	Kaval Bairasandra	74	1030	959-1101	554	275	201	71.19
86	BTM Layout	192	1023	913-1133	682	322	19	80.27
87	Vishveshwara Puram	174	1016	908-1124	720	255	41	73.08
88	Vijnana Nagar	92	1006	898-1114	599	407	0	65.84
89	Vidyaranyaपुरa	14	943	896-990	615	319	9	76.54
90	Kaveripura	149	913	810-1016	523	243	147	84.54
91	Nagavara	95	909	808-1010	601	211	97	79.02
92	Lakshmi Devi Nagar	42	906	813-999	566	340	0	82.31
93	Marappana Palya	50	890	787-993	702	166	22	86.25
94	Chamrajapet	165	876	774-978	362	199	315	75.95
95	Sir M. Vishweshwaraiah	46	866	770-962	375	282	209	67.17
96	T Dasarahalli	21	865	835-895	694	107	64	78.65
97	Srinagar	213	862	761-963	661	178	23	70.55
98	Jakkasandra	191	844	747-941	406	251	187	73.21
99	Nandini Layout	53	837	736-938	701	119	17	87.18
100	Adugodi	187	822	726-918	467	273	82	68.84
101	Kanneshwara Rama	39	792	699-885	494	298	0	68.97
102	Prakash Nagar	140	791	725-857	519	194	78	63.35
103	Nayandahalli	155	788	693-883	430	284	74	85.29
104	Neelasandra	183	788	692-884	287	430	71	82.55

Sl.No	Ward	Ward Number	Total Population	95 % CI	Gender population			Neutered (%)
					Male	Female	Unknown	
105	Subhash Nagar	134	776	680-872	355	252	169	84.59
106	Gali Anjenaya Temple ward	162	760	672-848	95	163	502	87.39
107	Amrutahalli	9	748	684-812	319	424	5	68.8
108	Rajeshwari Nagar	25	745	670-820	612	128	5	88.39
109	Pulikeshinagar	80	744	651-837	519	220	5	78.26
110	Shanthi Nagar	182	741	648-834	352	294	95	67.27
111	Uttarahalli	217	731	641-821	451	228	52	76.8
112	Dattatreya Temple	132	725	674-776	468	241	16	75.65
113	Nagarabhavi	153	724	632-816	458	187	79	89.63
114	Domlur	178	722	633-811	326	333	63	77.79
115	Ganga Nagar	72	716	625-807	326	261	129	68.35
116	Vinayakanagar	240	714	631-797	371	230	113	56.77
117	Sanjaya Nagar	67	711	622-800	417	166	128	76.3
118	Hebbala	70	707	617-797	432	188	87	79.38
119	Hongasandra	234	694	603-785	411	259	24	85.89
120	Muneshwara Nagar	76	686	595-777	283	212	191	84.42
121	J P Park	38	681	594-768	471	210	0	81.62
122	Babusab Palya	82	669	611-727	560	64	45	77.24
123	Lakkasandra	188	659	572-746	291	276	92	84.28
124	Kushal Nagar	75	654	571-737	286	212	156	73.69
125	Someshwara Ward	3	645	573-717	397	244	4	87.77
126	Ashoka Pillar	175	629	544-714	342	157	130	64.2
127	Dharmaraya Swamy Temple Ward	172	615	530-700	240	239	136	83.09
128	RBI layout	222	614	547-681	218	34	362	69.75
129	Konena Agrahara	125	606	523-689	289	127	190	76.92
130	Binnipete	136	592	509-675	309	233	50	84.02
131	Sampangiram Nagar	129	590	511-669	408	179	3	73.56
132	Subramanyapura	218	590	534-646	362	148	80	61.21
133	Hombegowda Nagara	177	586	504-668	258	137	191	53.31
134	Padmanabha Nagar	206	578	496-660	441	126	11	73.64
135	Yediyur	200	572	507-637	283	117	172	68.31
136	Vrisabhavathi Nagar	58	571	494-648	346	214	11	77.98
137	Vikram Nagar	205	557	478-636	355	200	2	78.01
138	HRBR Layout	99	554	482-626	456	42	56	85.37
139	Kacharkanahalli	98	552	475-629	382	96	74	86.71
140	Sunkadakatte	27	550	522-578	405	140	5	82.72
141	Sunkenahalli	173	546	469-623	331	96	119	64.99

Sl.No	Ward	Ward Number	Total Population	95 % CI	Gender population			Neutered (%)
					Male	Female	Unknown	
142	Ganesh Mandir ward	202	544	466-622	342	202	0	62.03
143	Lingarajapura	102	540	464-616	378	62	100	55.9
144	Okalipuram	135	533	455-611	314	215	4	67.96
145	Jeevanbhima Nagar	124	531	456-606	126	145	260	53.97
146	Ejipura	185	530	452-608	246	170	114	82.44
147	Kamakshipalya	145	526	453-599	349	174	3	83.38
148	Hoysala Nagar	120	514	440-588	391	90	33	83.333
149	S K Garden	78	511	437-585	327	111	73	63.97
150	Subramanya Nagar	62	506	430-582	241	237	28	74.33
151	Hosahalli	158	500	425-575	280	184	36	76.53
152	Girinagar	214	499	427-571	147	72	280	71.85
153	Maruthi Seva Nagar	103	490	420-560	350	115	25	79.13
154	AECS Layout	109	483	413-553	335	148	0	70.58
155	Bommanahalli	235	483	414-552	294	149	40	88.56
156	Bapuji Nagar	160	480	405-555	293	186	1	79.72
157	Nagapura	51	479	408-550	387	92	0	82.68
158	Ramaswamy Palya	126	479	408-550	380	97	2	55.15
159	Yelachenahalli	220	469	398-540	317	147	5	59.87
160	Deen Dayalu Ward	208	468	396-540	222	233	13	89.13
161	Devarachikkanahalli	236	459	414-504	240	216	3	81.15
162	Venkateshpura	97	456	383-529	169	165	122	53.39
163	Old Thippasandra	121	452	382-522	290	158	4	81.86
164	Kammanahalli	101	449	376-522	300	146	3	81.36
165	Sudham Nagara	171	448	377-519	287	137	24	78.72
166	Chunchaghatta	223	442	377-507	323	116	3	75.3
167	Chatrapati Shivaji	36	441	379-503	224	126	91	85.97
168	Shakthi Ganapathi Nagar	57	436	368-504	266	102	68	86.26
169	Chickpete	138	434	363-505	248	182	4	75.21
170	Chandra Layout	154	433	376-490	267	94	72	80.13
171	Someshwara Nagar	176	431	361-501	155	221	55	86.6
172	Shankar Matt	56	430	365-495	286	134	10	80.87
173	Gurappanapalya	194	429	358-500	165	136	128	57.69
174	Veera Sindhura Lakshamana	44	422	354-490	232	98	92	78.96
175	Vasanth Nagar	128	418	358-478	348	64	6	61.21
176	Kadu Malleshwara	64	412	346-478	242	160	10	82.83
177	Srinivasa Nagar	212	408	358-458	318	90	0	67.29
178	Mahalakshimpuram	52	404	337-471	314	85	5	87.13

Sl.No	Ward	Ward Number	Total Population	95 % CI	Gender population			Neutered (%)
					Male	Female	Unknown	
179	Kadugondanahalli	96	402	350-454	238	97	67	54.51
180	Rajaji Nagar	141	400	340-460	269	121	10	74.79
181	Ulsoor	131	394	331-457	222	121	51	83.55
182	N S Palya	193	392	335-449	244	146	2	80.4
183	Jaraganahalli	242	391	329-453	245	130	16	82.74
184	Gandhinagar	133	386	341-431	352	30	4	64.28
185	Jogupalya	179	386	321-451	144	234	8	73.28
186	Hosakerehalli	209	384	318-450	59	72	253	71.34
187	Sriramamandir	142	381	316-446	239	111	31	73.88
188	Ibluru	229	380	325-435	203	171	6	68.63
189	Munnekollala	113	377	334-420	363	14	0	57.83
190	Chalavadipalya	166	375	309-441	238	78	59	69.97
191	Manorayanapalya	69	375	322-428	199	150	26	80.96
192	Devara Jeevanahalli	77	364	313-415	144	160	60	72.11
193	Shakambari Nagar	197	364	322-406	305	4	55	73
194	Madivala	190	358	298-418	227	126	5	79.11
195	Puttenahalli - Sarakki Lake	241	356	302-410	163	185	8	73.14
196	Vijayanagar	157	352	301-403	259	90	3	77.65
197	Dr. Raj Kumar Ward	146	351	317-385	250	101	0	65.58
198	Medahalli	87	341	298-384	264	72	5	65.12
199	Mudalapalya	152	339	281-397	172	119	48	88.35
200	Agrahara Dasarahalli	147	333	271-395	197	131	5	81.9
201	Cottonpete	137	328	269-387	209	87	32	72.44
202	Tilak Nagar	195	324	265-383	217	107	0	88.61
203	Malleswaram	61	319	263-375	181	136	2	86.35
204	Govindaraja Nagar	148	318	260-376	185	87	46	83.11
205	Attiguppe	161	316	275-357	118	145	53	71.59
206	Hampi Nagar	159	314	270-358	216	95	3	81.27
207	Vannarapete	184	314	256-372	163	139	12	74.21
208	Jai Maruthinagara	54	312	259-365	172	74	66	82.56
209	Basaveshwara Nagar	144	310	256-364	215	91	4	86.5
210	Azad Nagar	170	308	255-361	140	89	79	69.48
211	Basavanagudi	210	304	247-361	148	74	82	61.14
212	Vidyapeeta ward	216	300	275-325	191	107	2	78.53
213	Mattikere	59	294	241-347	167	123	4	88.27
214	J P Nagar	198	288	234-342	252	4	32	69.11

Sl.No	Ward	Ward Number	Total Population	95 % CI	Gender population			Neutered (%)
					Male	Female	Unknown	
215	Jalakanteshwara Nagara	123	288	245-331	209	79	0	70.52
216	Bharathi Nagar	130	281	227-335	227	41	13	70.61
217	Banashankari Temple ward	203	279	225-333	203	55	21	68.67
218	Chamundi Nagara	71	276	224-328	195	81	0	67.2
219	Marenahalli	150	275	222-328	190	43	42	81.51
220	Katriguppe	215	270	218-322	170	56	44	83.48
221	Sagayarapuram	79	268	221-315	249	19	0	53.33
222	Hanumanth Nagar	211	266	248-284	147	117	2	82.02
223	Chanakya	37	264	212-316	187	77	0	88.48
224	Gayithri Nagar	63	261	207-315	189	65	7	62.44
225	Avalahalli	164	259	247-271	125	130	4	88.01
226	Kumaraswamy Layout	204	258	210-306	143	113	2	84.43
227	Umamaheshwara Ward	201	250	210-290	122	128	0	73.53
228	Sarakki	199	238	193-283	164	26	48	70.94
229	Rajamahal Guttahalli	65	234	185-283	114	89	31	62.14
230	Suddagunte Palya	189	234	193-275	143	82	9	85.41
231	Dayananda Nagar	139	222	172-272	161	60	1	70.26
232	Veerabhadranagar	163	221	176-266	120	97	4	83.75
233	Maruthi Mandir ward	151	220	174-266	155	37	28	81.64
234	Jagajivanaram Nagar	167	216	176-256	130	86	0	75.11
235	A Narayanapura	91	209	158-260	103	103	3	57.76
236	Shivanagara	143	208	161-255	101	88	19	83.49
237	Defence Colony	19	191	167-215	182	3	6	66.21
238	Devaraj Urs Nagar	169	184	140-228	133	40	11	69.09
239	Yelahanka Satellite Town	5	164	138-190	16	148	0	50.31
240	Puneet Rajkumar	55	120	119-121	83	32	5	88.47
241	Padarayanapura	168	109	78-140	69	36	4	86.09
242	Kempapura Agrahara	156	92	47-137	55	37	0	74.83
243	Kamakya Nagar	207	74	54-94	65	6	3	67.77
	Total	243	279335	277450 - 281220	165341	82757	31237	71.85

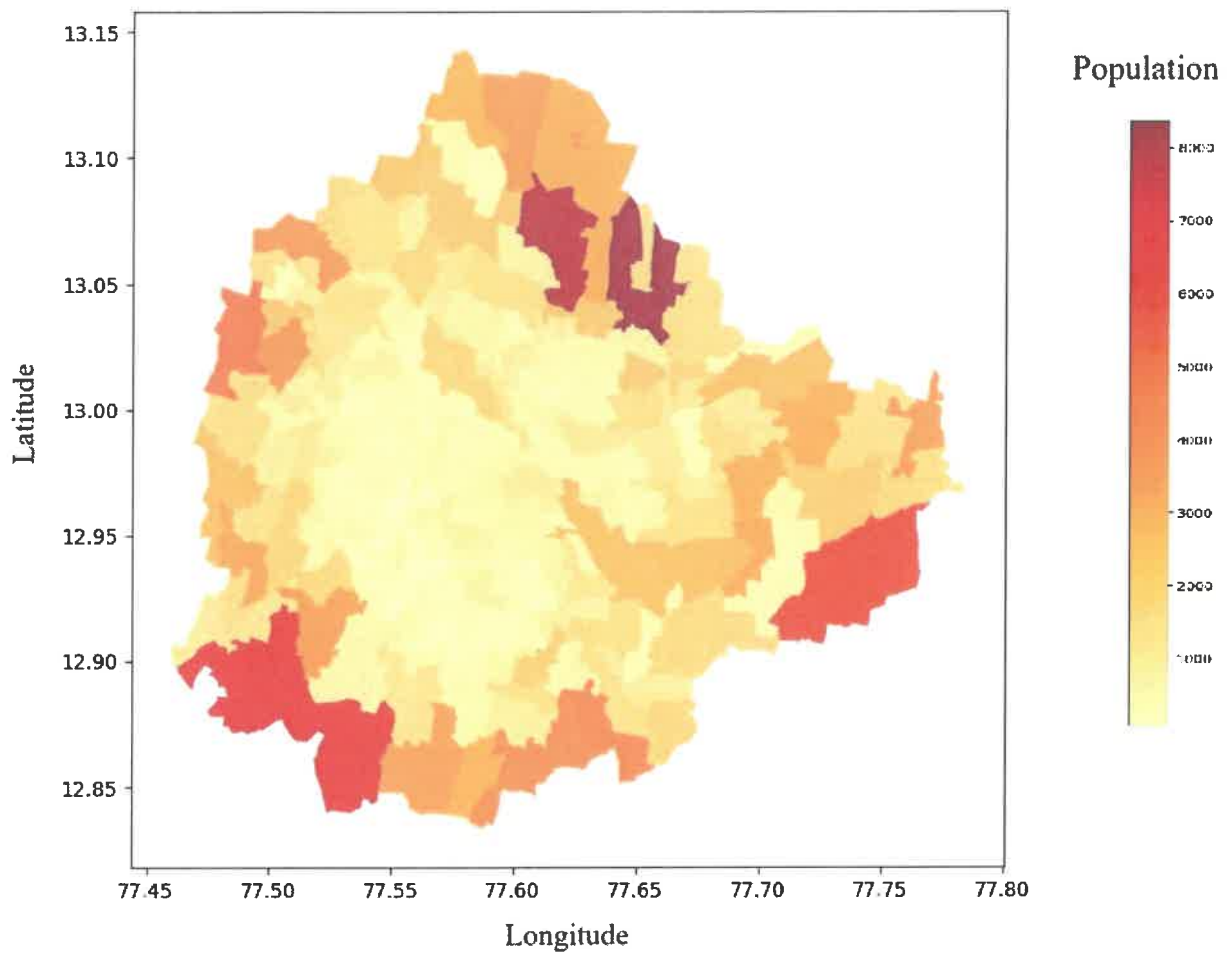


Figure 2: Street Dog population mapping in BBMP Wards

ICAR

Ward wise distribution of estimated Street Dog population within each BBMP zones

Bengaluru East

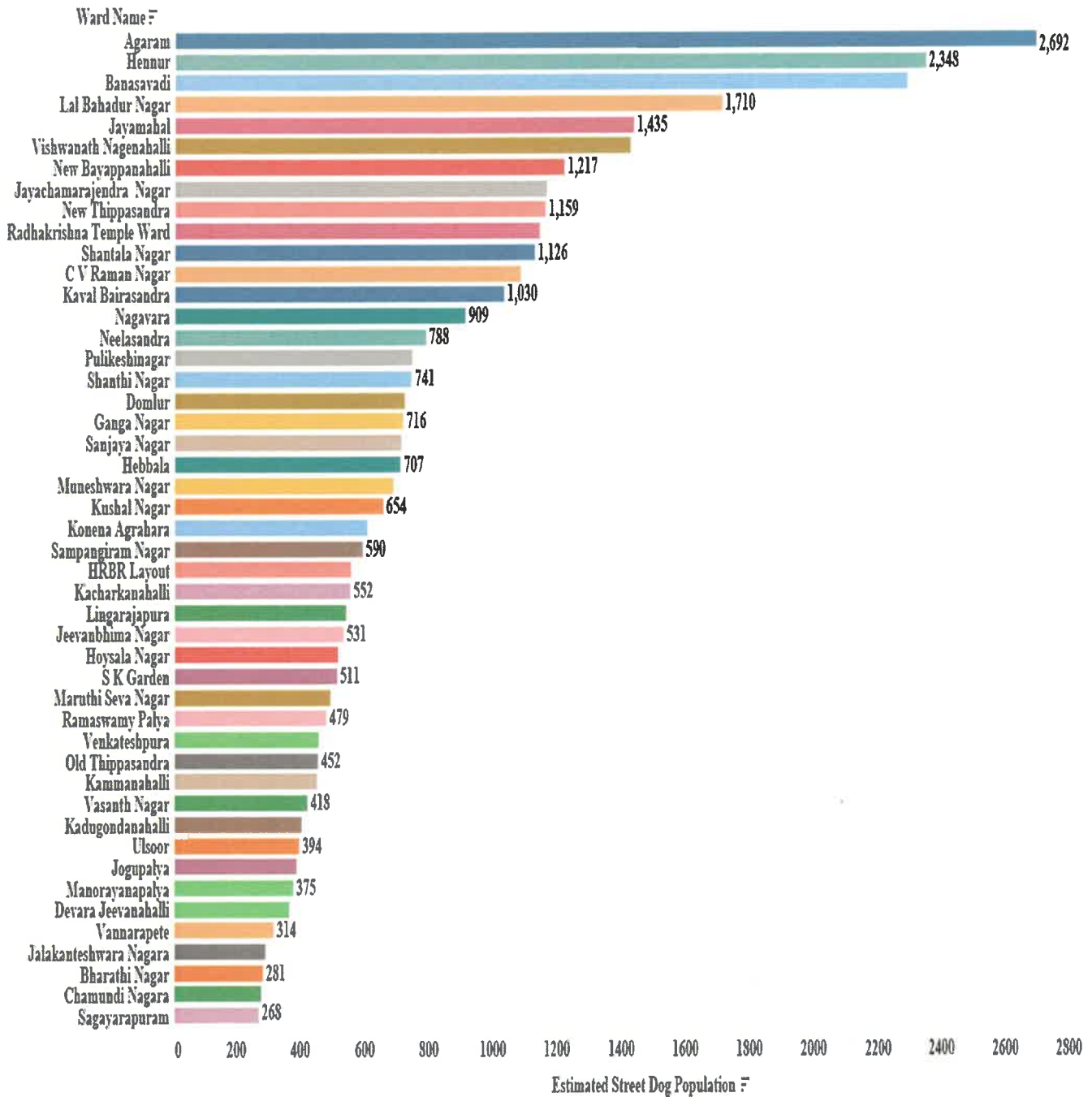


Figure 3: Ward wise distribution of Estimated Street Dog population within Bengaluru East zone

Zone Name	Total No of Wards
Bengaluru East	47

Bommanahalli

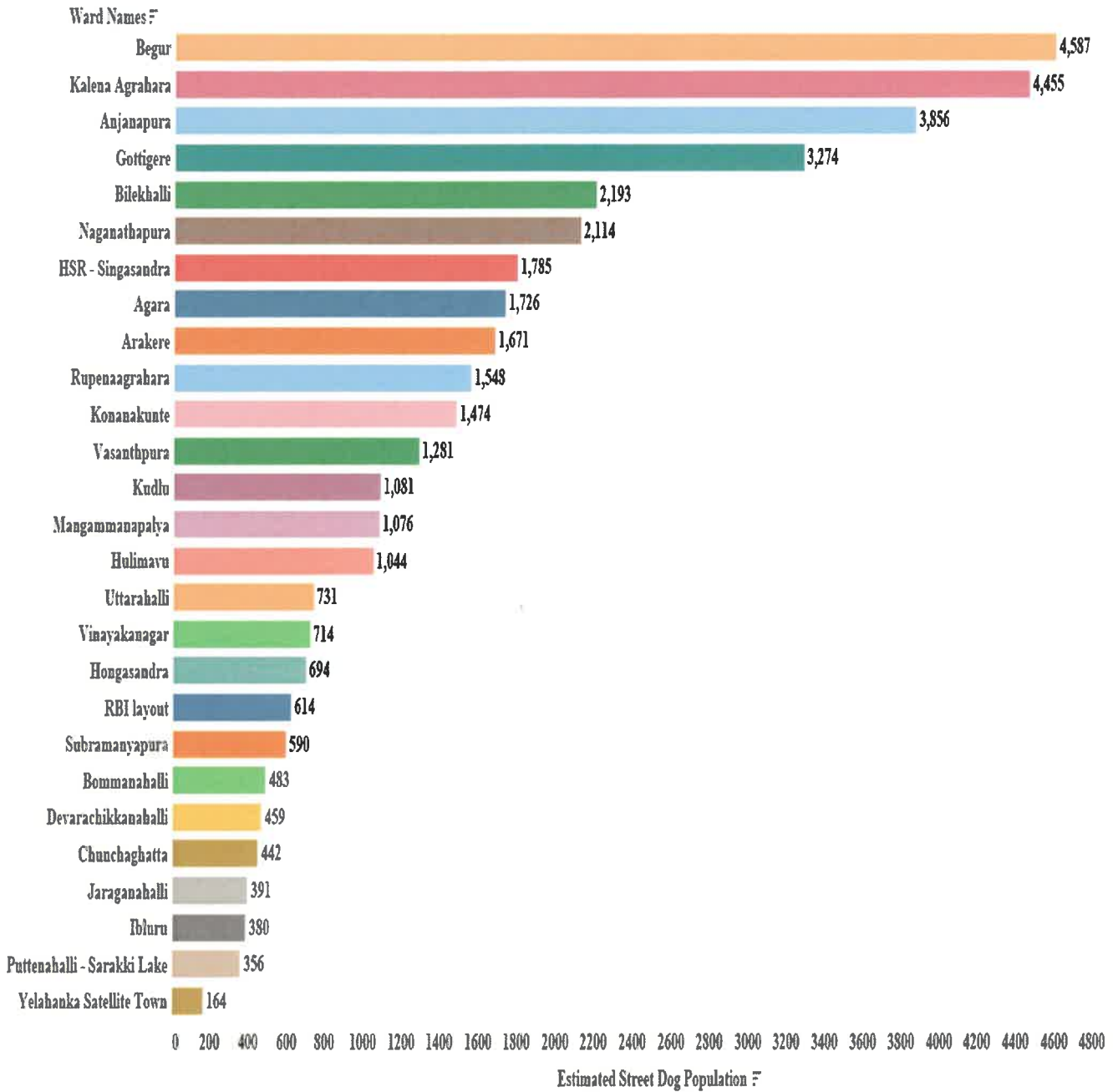


Figure 4: Zone2 - Bommanahalli Estimated Street Dog population distribution

Zone Name	Total No of Wards
Bommanahalli	27

Bengaluru South

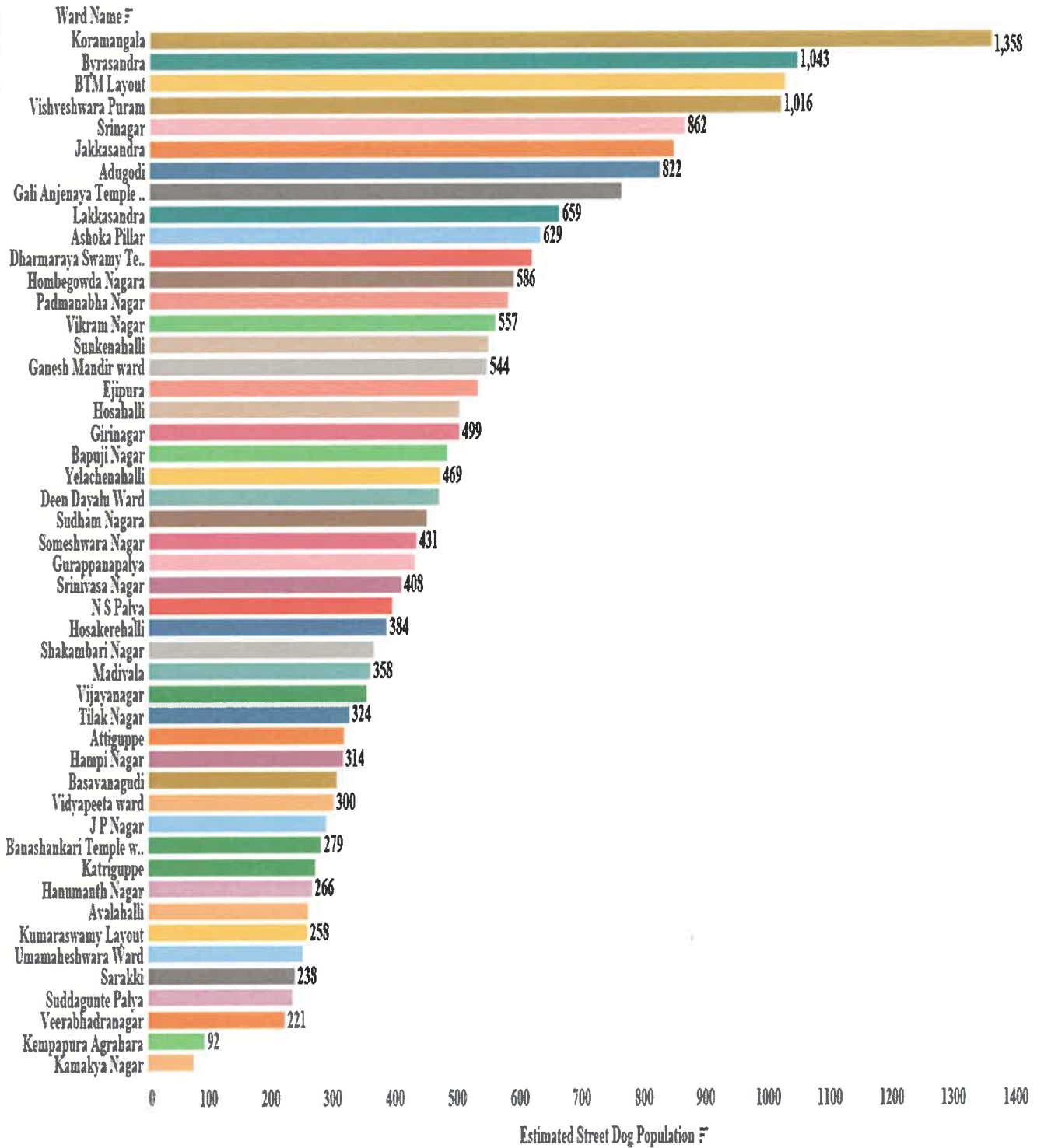


Figure 5: Zone3 - Bengaluru South Estimated Street Dog population distribution

Zone Name	Total No of Wards
Bengaluru South	48

Bengaluru West

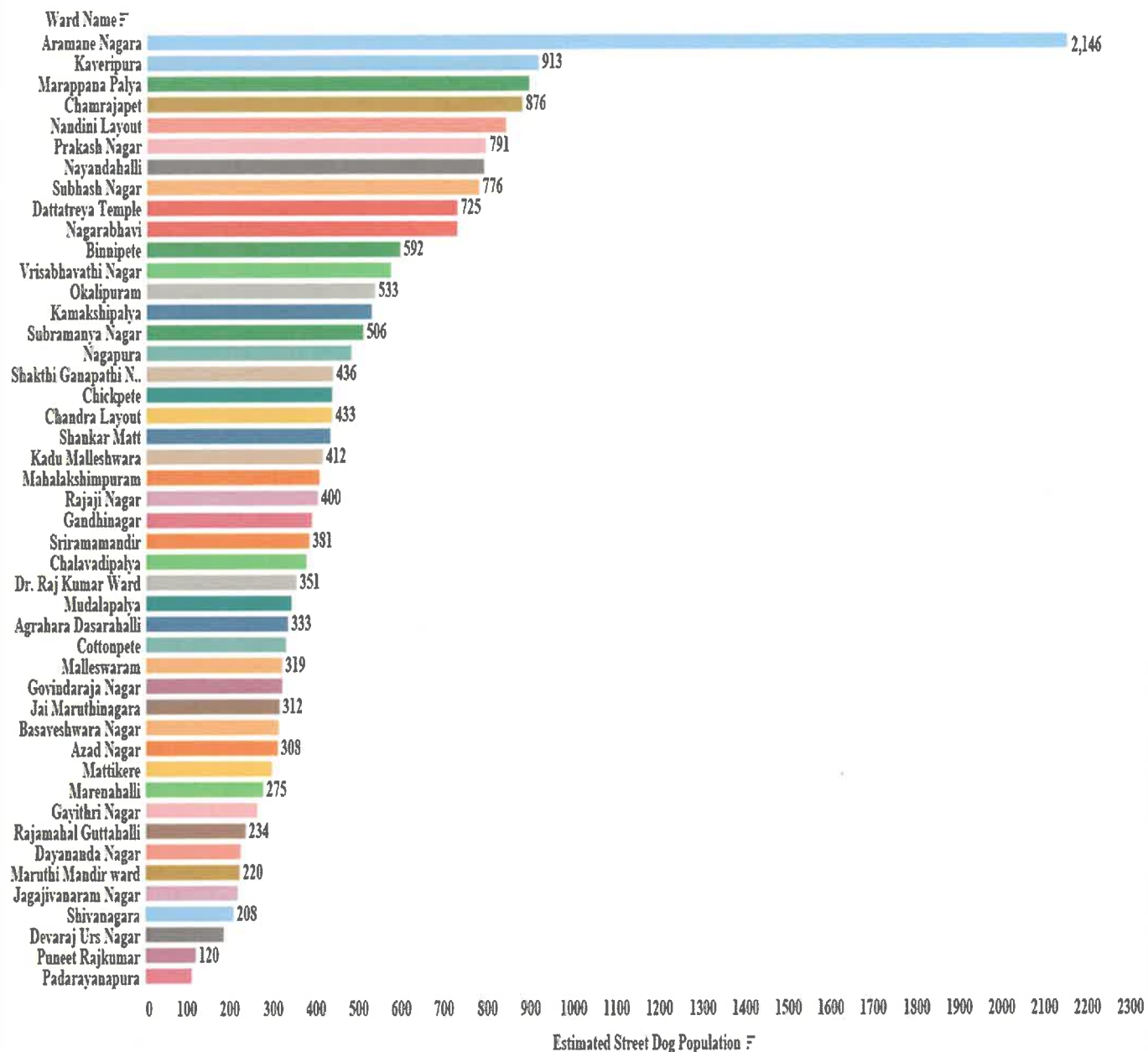


Figure 6: Zone4 - Bengaluru West Estimated Street Dog population distribution

Zone Name	Total No of Wards
Bengaluru West	46

Dasarahalli

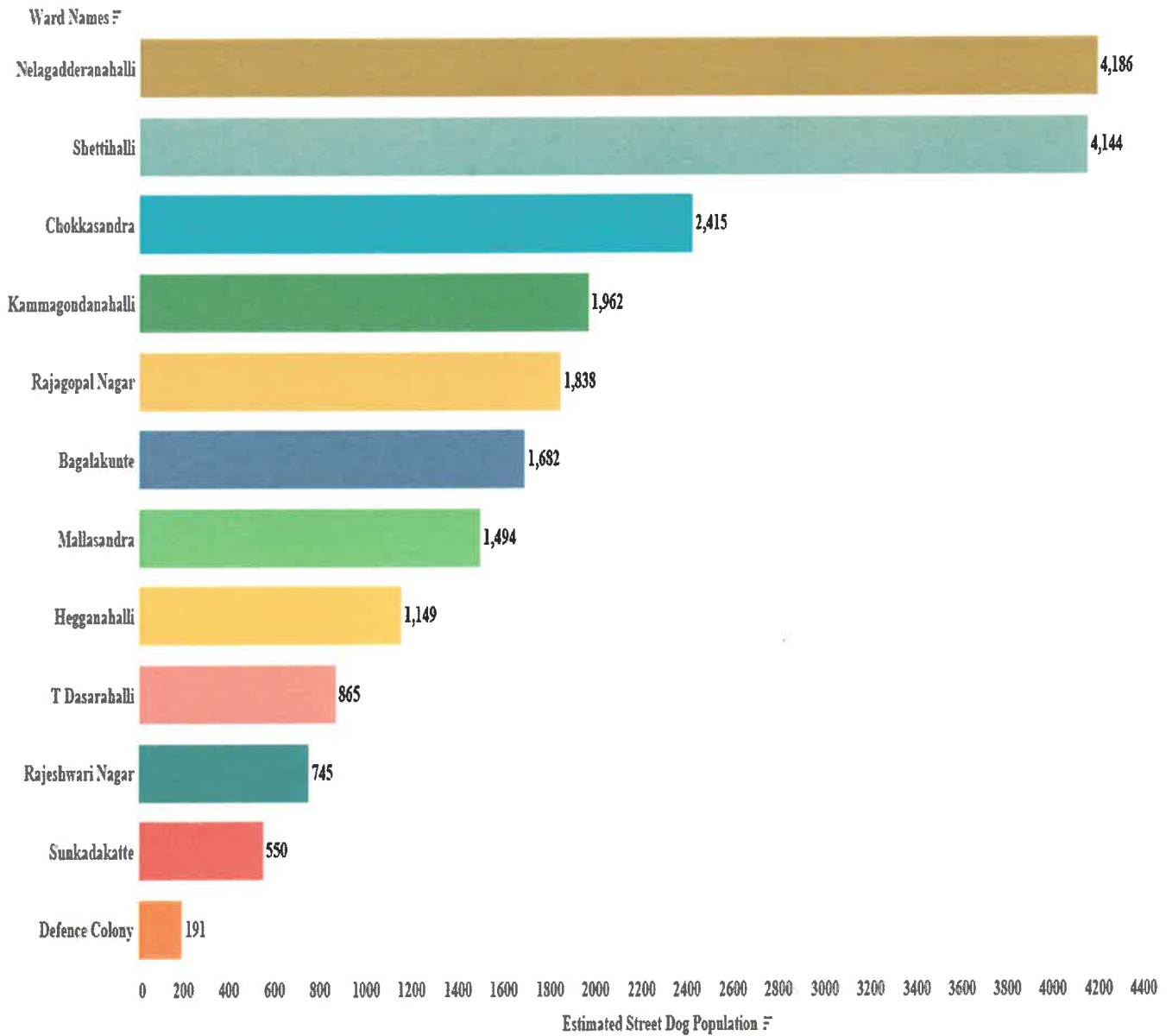


Figure 7: Zone5 - Dasarahalli Estimated Street Dog population distribution

Zone Name	Total No of Wards
Dasarahalli	12

Mahadevapura

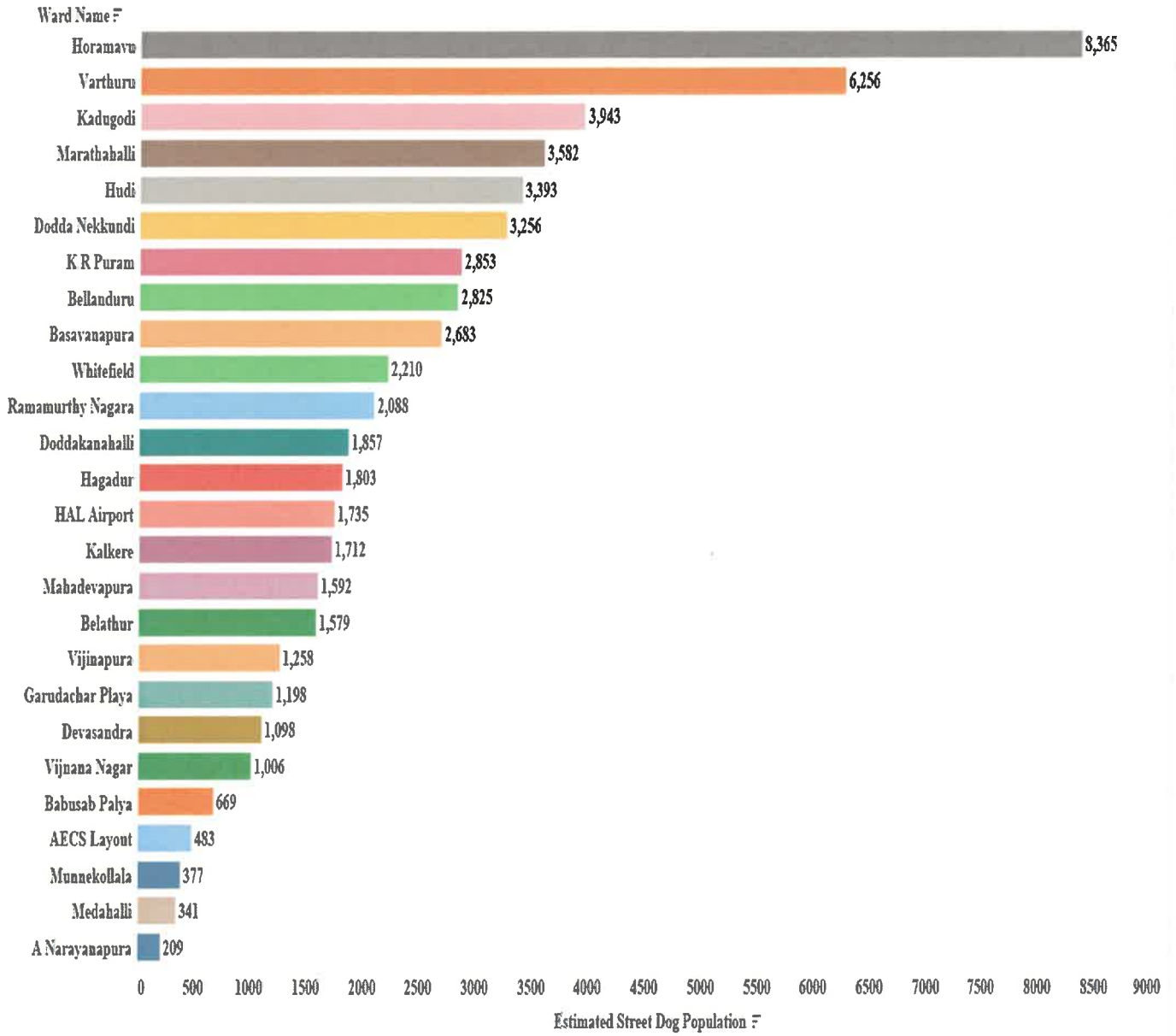


Figure 8: Zone6 - Mahadevapura Estimated Street Dog population distribution

Zone Name	Total No of Wards
Mahadevapura	26

R R Nagar

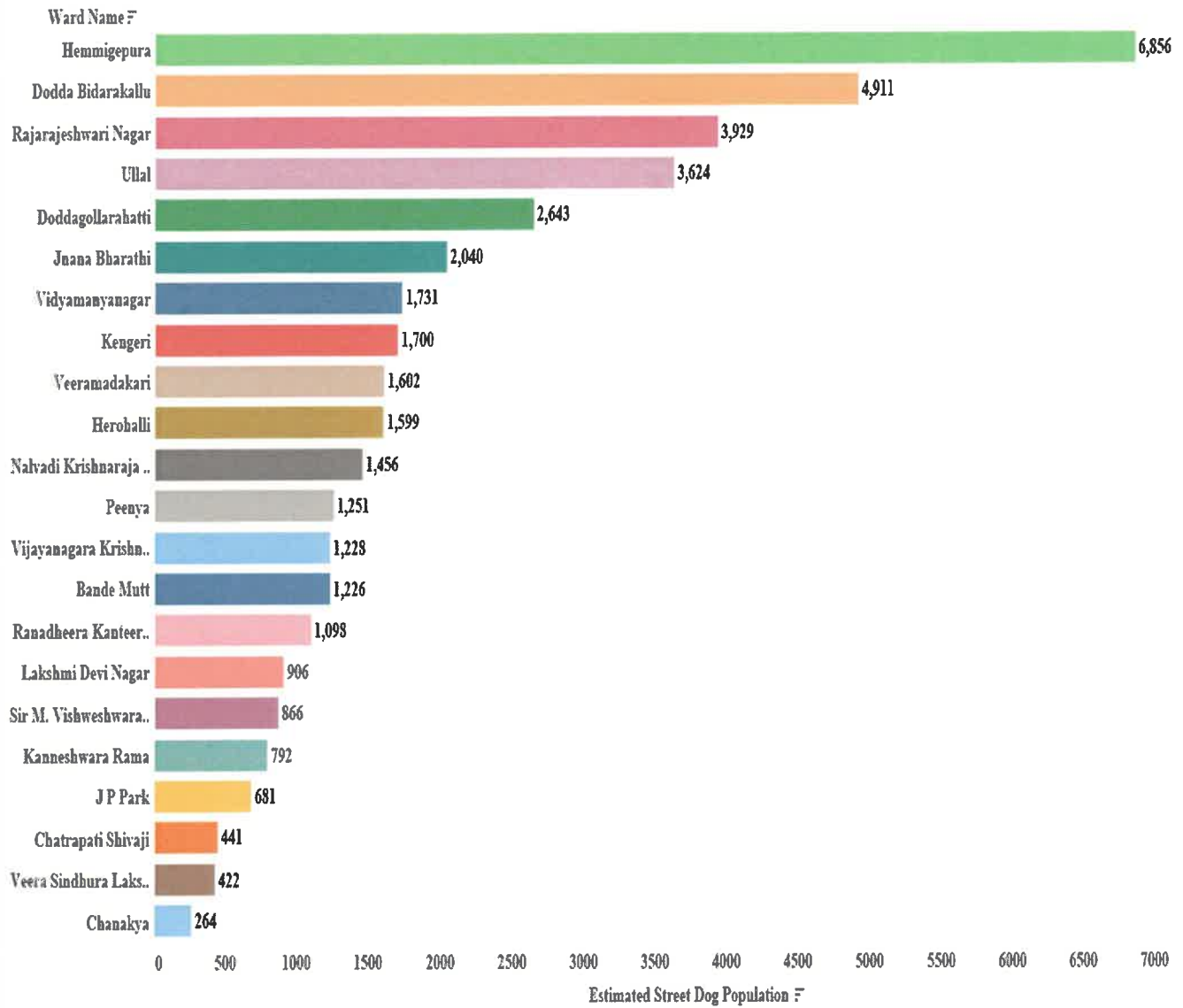


Figure 9: Zone7 – R R Nagar Estimated Street Dog population distribution

Zone Name	Total No of Wards
R R Nagar	22

Yelahanka

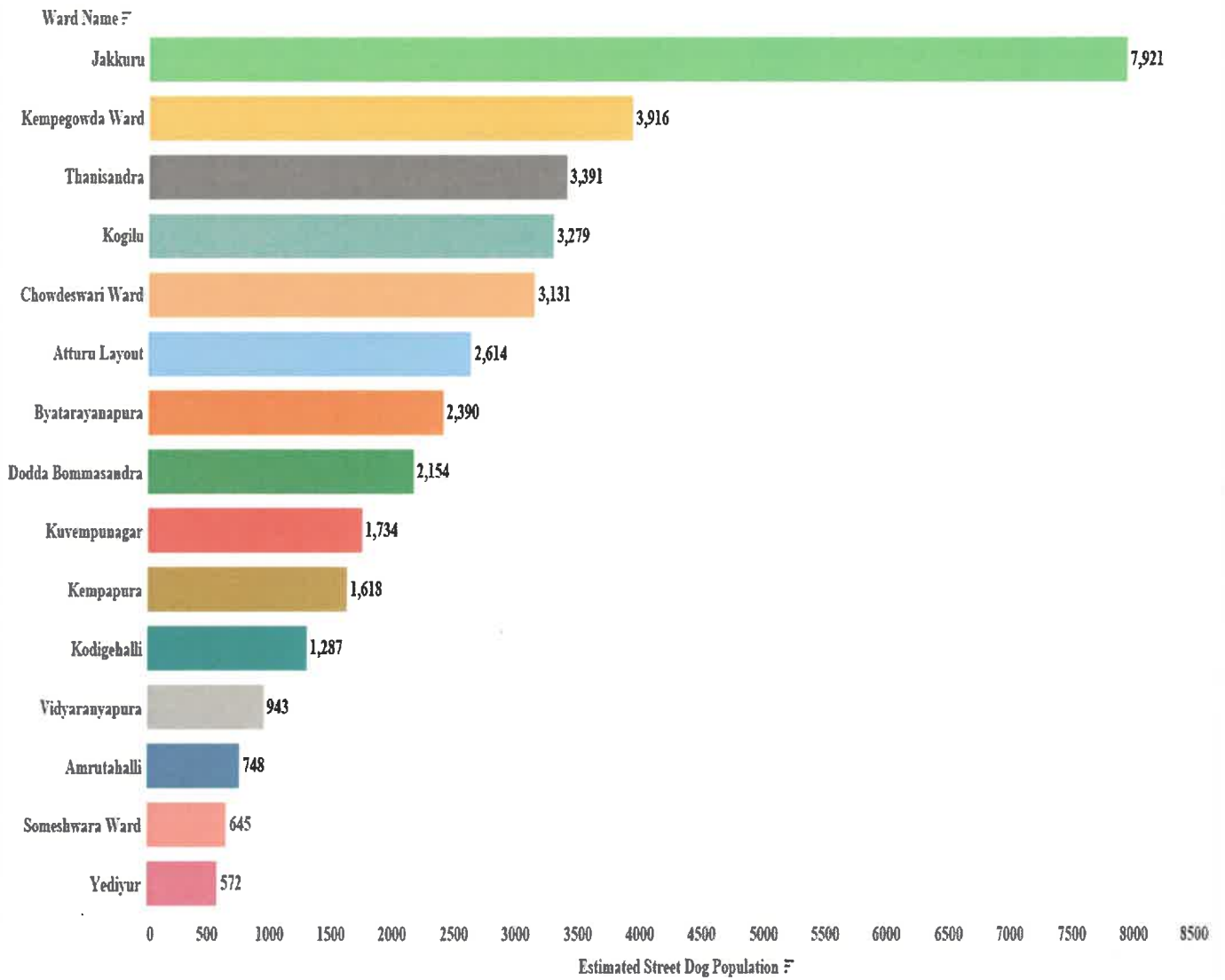


Figure 10: Zone8 - Yelahanka Estimated Street Dog population distribution

Zone Name	Total No of Wards
Yelahanka	15

Top 30 Ward Wise Wstimated Street Dog Population

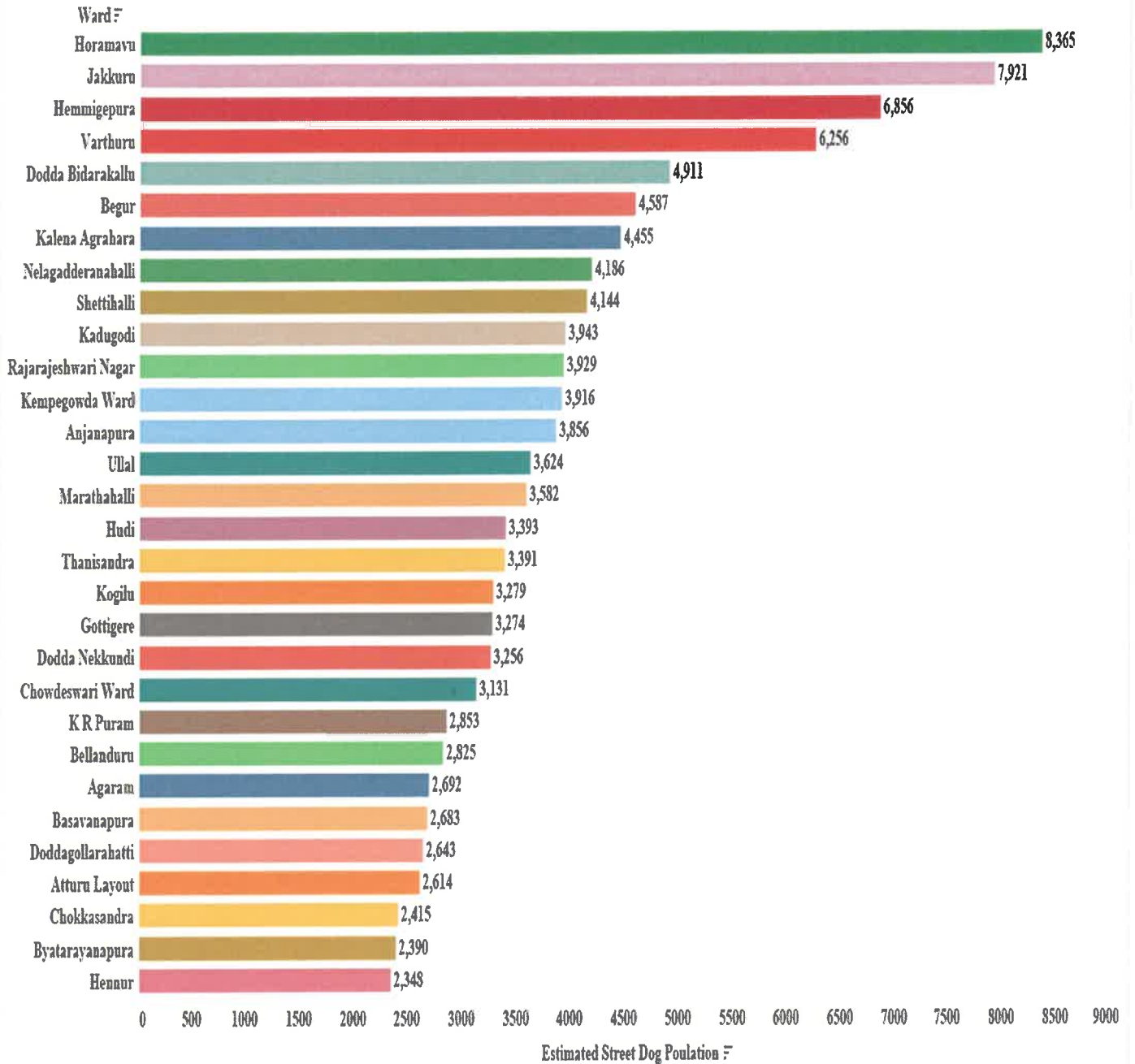


Figure 11: Top 30 Wards as per estimated street dog population within BBMP limits

3.1.2. Comprehensive Insights from Population Data

The total population estimates for 6850 micro zones provide insight into the BBMP limits. The estimate of approximately 2,79,335 Street Dogs reflects the vast scale of canine habitation. The inclusion of Confidence Intervals adds to the precision of these figures, acknowledging the potential range of the true population.

The synthesis of these insights yields a comprehensive portrait of Street Dog habitation in Bengaluru. The urban landscape showcases variations in population density, localized tendencies and overarching trends. Commercial areas emerge as hubs of Street Dog activity, highlighting the complex interplay between human activities and canine habitation. The prevalence of Street Dogs in commercial areas can be attributed to multiple factors like the presence of food establishments, food traffic, and the availability of potential resources.

3.2. Sample estimation Insights

The sample estimation process within the BBMP Street Dog Survey offers valuable insights into the demographic attributes of the Street Dog population. By delving into the percentages of Gender, neutering status, and age distribution, this aspect of the survey enriches our understanding of the Street Dog ecosystem in Bengaluru.

Table 5. Percentage distribution of dogs based on Age, Gender and Neutered Status

Gender (%)			
Categories	1st Sight	2nd Sight	Overall
Male	61.18	56.83	59.05
Female	29.64	29.22	29.28
Unknown	9.18	13.95	11.565
Age (%)			
Adult	96.49	97.68	97.08
Puppy	3.06	2.32	2.69
NA	0.45	-	0.23
Neutered Status (%)			
Entire	23.69	20.04	21.86
Neutered	69.59	74.11	71.85
Unknown neuter	6.72	5.85	6.28

Table 6. Percentage distribution of dogs based on Neutered status and gender

Categories	Entire (%)	Neutered (%)	Unknown neuter (%)
Male	21.88	74.60	3.52
Female	23.91	72.11	3.98
Unknown	16.37	56.94	6.69
Grand Total	21.86	71.85	6.28

3.2.2. Comprehensive Insights from Sample Data

The dominance of male Street Dogs, as indicated by the higher percentage, points to a distinct gender imbalance within the population. This observation raises questions about factors influencing the gender ratio and the potential implications for population dynamics.

The prevalence of adult Street Dogs among the sampled population underscores the established presence of mature canines within the urban landscape. This trend hints at the stability and effective execution of ABC program over time.

The larger percentage of neutered Street Dogs highlights the impact of ongoing sterilization programs. A higher neutering percentage suggests a proactive approach to curbing overpopulation and controlling the spread of diseases. This positive trend demonstrates the efficacy of community initiatives and their contribution to responsible Street Dog management.

3.3 Analysing Street Dog Population Trends: A Perspective through CAGR

To gain a comprehensive understanding of the changes in Street Dog populations, it's essential to delve into the data from the previous year and the current year. One effective tool for this analysis is the Compound Annual Growth Rate (CAGR). It offers a dynamic lens through which we can assess the average annual growth or decline in the Street Dog population over a specified period. It helps us discern the trajectory of change by considering both past and current figures. CAGR is calculated as follows.

$$\text{CAGR} = \left[\left(\frac{\text{Current Year Population}}{\text{Previous Year Population}} \right)^{\frac{1}{\text{Number of Years}}} - 1 \right] \times 100$$

Here, "Current Year Population" represents the Street Dog population in the present survey, "Previous Years Population" denotes the population in the previous survey, and "Number of Years" signifies the time elapsed between the two data points. A positive CAGR suggests an average annual increase in Street Dog populations, while a negative CAGR indicates a decrease. This metric is valuable in quantifying the rate of change and provides insights into the trends shaping our urban canine landscape.

Application of CAGR to our data, allows us to make informed decisions and tailor interventions to the evolving needs of our city's Street Dog population. It also enables us to gauge the effectiveness of our efforts in managing these vital urban inhabitants. Table 5 gives us the CGAR for various parameters.

Table 7. CAGR for Total population, Male and Female population and Neutered status

	2019	2023	CAGR (%)*
Total Population	3,09,898	2,79,335	-5.41
Male population	205660	165341	-5.31
Female Population	104316	82757	-5.62
Total Neutered	158588	200608	6.05

*Unknown population is removed for the CAGR calculation

From the above table it is evident from the data that the total Street Dog population has experienced a decrease in its growth rate. Both male and female Street Dog populations also exhibit a decrease in their growth rates. In contrast, the growth rate of neutered Street Dogs shows an increase. This is a positive indicator, reflecting the impact of neutering and spaying campaigns. These trends highlight the effectiveness of population management strategies and initiatives focused on neutering and spaying. They also underscore the importance of continued efforts to monitor and manage the Street Dog population

4. Discussion

The estimation of a Street Dog population of approximately **279335** within the surveyed area serves as a pivotal benchmark. This all-encompassing figure not only highlights the magnitude of canine habitation but also underscores the need for evidence-based urban management strategies. The inclusion of Confidence Intervals further bolsters the credibility of this estimation, acknowledging the inherent variability in survey data.

The categorization of Street Dog populations into Slums, Lakes, Commercial, and Other Areas provides a contextual lens through which to view their dynamics. The insights drawn from these categories reveal the influence of diverse urban environments on canine habitation. The dominance of Street Dogs in Commercial area and the nuances within Slums and Other Areas enrich our understanding of canine behaviour and coexistence in different contexts.

The analysis of Gender distribution, age composition, and neutering status within the sampled Street Dog population adds depth to our comprehension. The observed male dominance, prevalence of adult dogs, and significant neutering efforts have far-reaching implications for urban management. These insights guide the formulation of gender-sensitive strategies, age-specific interventions, and the continuation of successful neutering initiatives.

The synthesis of total dog population estimates, zonal dynamics, ward wise insights, categorized dynamics, and sample output insights presents a panoramic view of Street Dog dynamics in Bengaluru. The collective findings underscore the complexity of canine habitation in urban spaces, encapsulating nuances, disparities, and trends that resonate across wards and zones.

The comprehensive understanding garnered from this synthesis forms the bedrock for responsible urban management. By acknowledging the multifaceted nuances within zonal and ward wise dynamics, stakeholders are empowered to tailor interventions and strategies that align with specific needs. This holistic approach encompasses gender imbalances, age-specific healthcare, and targeted neutering campaigns, ushering in an era of harmonious coexistence and welfare for both humans and Street Dog

5. Conclusion

In conclusion, the BBMP Street Dog Survey stands as a testament to the commitment of responsible urban management and compassionate coexistence. The insights gleaned from this comprehensive study provide a multi-dimensional understanding of Street Dog populations, categorizations, and demographic attributes within Bengaluru's diverse urban landscape.

One notable aspect in comparison with previous surveys, the present study reveals a decrease in the overall street dog population. There is a 10% reduction in the street-dog population as compared to previous survey (Bengaluru Street dog survey- 2019) which had estimated the Street Dog Population as 3,10,000. At the same time overall Neutering percentage has increased by 20% from the estimated 51.16% in 2019 to 71.85% in the present study. This decline in population points to the effectiveness of intervention efforts aimed at population control and responsible management. The success of initiatives such as neutering campaigns and community-driven strategies highlights the collective dedication to ensuring a harmonious balance between street dogs and city residents.

As we move forward, armed with these invaluable insights, we stand poised to create a blueprint for responsible urban management that fosters a compassionate and secure environment for both humans and Street Dogs. The BBMP Street Dog Survey not only underlines the significance of evidence-driven policies but also exemplifies the power of collective action in shaping positive outcomes for our city and its four-legged companions.

6. Limitations and Future Avenues of Exploration

While the BBMP Street Dog Survey has yielded valuable insights into the urban canine landscape of Bengaluru, it is important to acknowledge its limitations and consider potential areas for future improvement

6.1. Limitations

- Though sufficient number of samples are taken for estimation of dog population, it may not fully represent the entire Street Dog population. Variability in behaviour, movement patterns, and locations could result in underestimation or overestimation of certain population attributes.
- The survey's snapshot approach may not capture seasonal or temporal fluctuations in Street Dog populations. Factors like weather, food availability, and mating seasons can impact population dynamics.
- The survey's focus on sampled micro zones might exclude certain areas where Street Dogs also inhabit. These non-sampled zones could contain unique characteristics and challenges not accounted for in the study.
- The reliance on visual observations and photographs might lead to inaccuracies in identifying gender, age, and neutering status. Misclassification could affect the quality of demographic insights.
- The restricted area of survey coverage can affect the generalizability of findings to the broader cityscape and may not fully encapsulate the diversity of Street Dog populations in Bengaluru.

6.2 Future Line of work

- **Longitudinal Studies:** Conducting surveys over multiple time points can provide a more comprehensive understanding of population trends, accounting for seasonal and yearly variations.

- **Behavioural Studies:** Exploring the behaviour and movement patterns of Street Dogs can offer insights into their interactions with humans, their territories, and potential conflicts.
- **Community Engagement:** Involving local communities in data collection and management strategies can enhance accuracy and promote a sense of ownership and responsibility.
- **Health Assessments:** Integrating health assessments into surveys can provide insights into disease prevalence, vaccination needs, and overall canine welfare.
- **Genetic Studies:** Genetic analysis of Street Dog populations can shed light on lineage, migration patterns, and genetic diversity, contributing to a more holistic understanding.
- **Long-Term Impact Assessment:** Future surveys can assess the long-term impact of interventions, helping gauge the success of population control strategies and identifying areas that need further attention.
- **Digital Tools:** Utilizing advanced technologies like AI for automated data collection and analysis can improve accuracy and efficiency in data processing.
- **Public Awareness:** Continuously engaging with the public to raise awareness about responsible pet ownership, sterilization benefits, and the importance of coexistence can contribute to sustainable change.

Recommendations:

1. The Services of Animal/Dog feeders and Care-takers should be optimally utilized in promoting responsible feeding and to capture street –Dog for Sterilization.
2. Primary importance should be given to proper waste/garbage management, as the number of dogs in the area is directly proportional to the availability of food.
3. Focussing and insisting on implementation of ABC-ARV programme in grama panchayat areas to avoid the influx of un neutered street dogs into BBMP area.
4. To prioritize and emphasise ABC-ARV programme in wards where the Neutering percentage is less than the overall observed Average Neutering percentage
5. To carry-out more intensive ABC-ARV programme in the 30 wards which have higher Street-Dog population
6. The Animal Welfare Organizations should promote adoption of Street-dog puppies and their immunization in the best interest of Animal Health and Public Health
7. To carry-out regular Public Health Awareness programme about Zoonotic diseases caused by Dogs and its prevention.
8. To provide the guidelines on how to deal with human and stray dog conflicts without relocating the dogs in an area.
9. Implement strict pet ownership laws, prohibit people from carelessly feeding dogs everywhere, and setup facilities to house dogs in order to reduce the street dog population.

Street Dog Estimation Survey 2023 Committee Members:

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1	Dr.P.Srinivasu	Additional Director, Dept of AHVS	Chairman
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Appendix

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Draft Report presentation photos @BBMP office with Honourable Special Commissioner and team on 05-09-2023



Final Report preparation photos @ ICAR-NIVEDI on 07-09-2023

